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# OPERATIVE SURGERY.

## CHAPTER XIII.

### *OPERATIONS ON THE MOUTH, PHARYNX, NOSE, AND ŒSOPHAGUS.*

**Salivary Fistula.**—In salivary fistula the saliva is discharged on the external surface of the cheek instead of into the mouth. The object of an operation is to establish an internal communication with the duct so that the external opening can heal.

The cure may first be attempted by the older method of passing the ends of several long silken threads through the external opening, directly into the mouth or through the internal opening of the duct, and bringing them out at the angle of the mouth and tying their extremities (Fig. 730). An internal communication is easily established in eight or ten days, then the seton can be removed and the borders of the external opening freshened and closed. During the healing of the external opening the patient should be advised to chew upon the opposite side in order to limit as much as possible the flow of saliva on the diseased side.

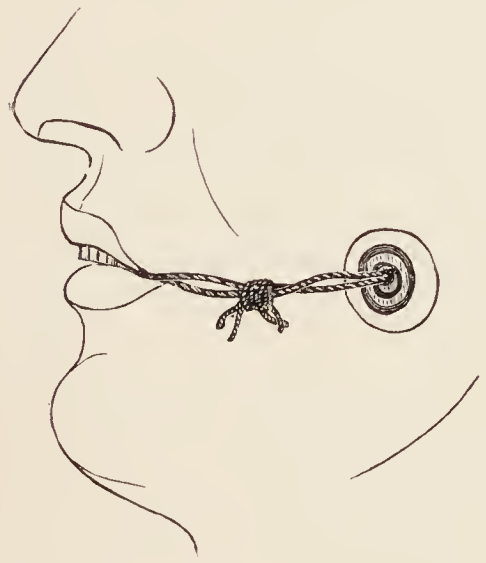


FIG. 730.—Seton method of treatment.

*Agnew's Method.*—Agnew's method consists in passing a good-sized thread of silk into the mouth, through the fistula, from without inward, and leaving it there, removing the needle and attaching to it the end of the thread remaining outside, and carrying it through the tissues into the mouth in the same direction as the former, but not exactly in the same track, thus including a small portion of buccal tissue. The needle is then removed, and the extremities of the thread are firmly tied within the mouth or round the inclosed tissue. A fine rubber ligature can be substituted for the silk. The loop cuts its way through the tissues grasped, forming an internal opening, which permits the healing of the external one.

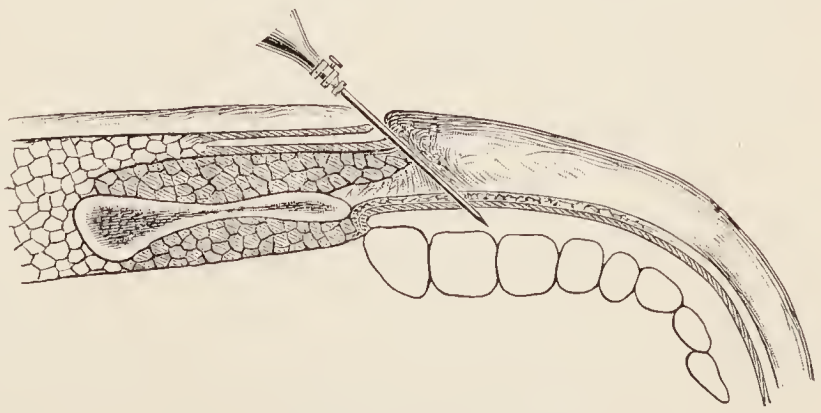


FIG. 731.—Desault's method.

*Desault's Method.*—Desault carried a small trocar from the fistulous opening forward and inward, entering the mouth opposite to the second molar tooth (Fig. 731). A seton

was drawn into the channel made by the instrument and retained until a patent canal was formed through which the saliva flowed, followed by healing of the external opening.

*Van Buren's Method.*—Van Buren cured an obstinate case by turning the end of the duct into the mouth in the following manner: A small probe was introduced into the duct from without to steady it during dissection and indicate its situation so as to prevent cutting it. The distal end of the duct was exposed for a short distance by careful dissection, and was then passed into the mouth through a small incision made through the buccal mucous membrane and confined there with horsehair sutures. The external opening was refreshened and closed at once.

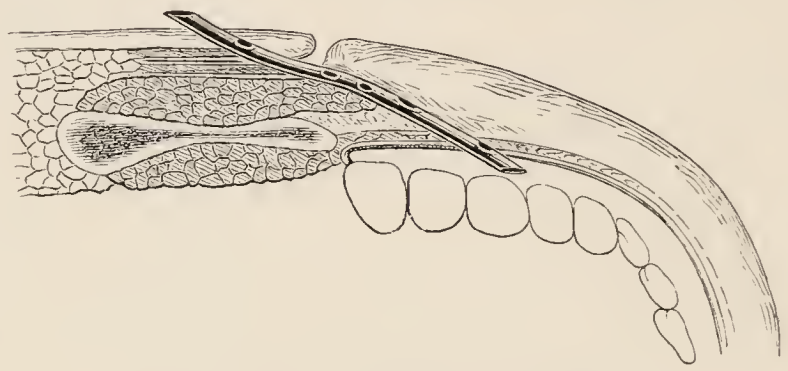


Fig. 732.—Richelot's method.

*Richelot's Method.*—Richelot inserted into the fistula a small rubber tube so as to cause one end to project slightly into the mouth, while the other end was cut off obliquely and so placed that the saliva could flow directly into the tube (Fig. 732). Thereafter the external wound healed promptly.

*Dequise's Method.*—Dequise made a puncture through the fistula, opening obliquely backward and inward to the inner surface of the cheek, and passed through it one end of a leaden wire (Fig. 733). A second puncture was then made through the same external opening, but directed obliquely forward to the inner surface, through which the other end of the wire was passed into the mouth and united snugly with its fellow by twisting. The parotid secretion promptly followed the leaden guides into the mouth, and the external opening quickly healed.

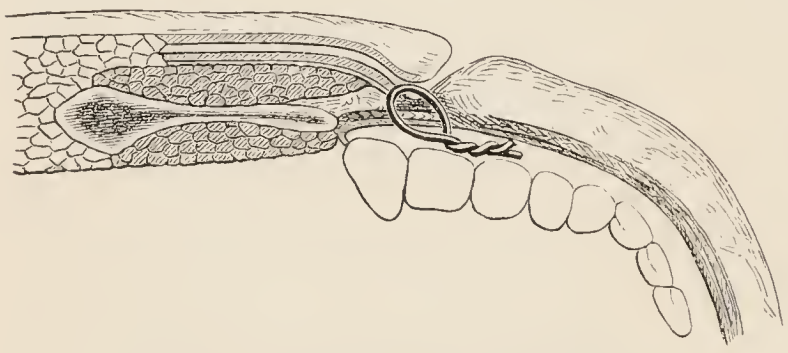


Fig. 733.—Dequise's method.

**Excision of the Tonsil.**—The excision of the tonsil can be done with an ordinary bistoury or with curved scissors, aided by a tenaculum. The various forms of tonsillotomes, while they simplify the operation by giving the operator a perfect control over the cutting edge, are not necessary to its execution.

*The Removal of the Tonsil with the Knife or Scissors.*—If the patient be young or unable to exercise self-control, give an anæsthetic, or apply to the tonsil a strong solution of cocaine. Cause a bright light to shine into the open mouth; depress the tongue; seize the tonsil with the tenaculum or forceps, draw it inward from between the pillars of the fauces, and with scissors curved on the flat, or with the probe-pointed bistoury, or an ordinary bistoury with the point guarded by adhesive plaster, sever the tonsil from below upward. It is not necessary at first to remove the entire tonsil, since a curative influence is often established by an incomplete removal.

Among the tonsillotomes in common use are Mathieu's and Mackenzie's. In using the instrument the patient is placed as before stated, and the ring of the instrument is adjusted around the tonsil with the aid of the index finger; the tonsil is elevated by a tenaculum, or by a special hook of the instrument, and severed by pressing the blade against it.

*The Results.*—Any undue hæmorrhage can be controlled by ice, pressure, and astringents; actual cautery is rarely needed. In four instances the internal carotid artery has been wounded by recklessness in cutting the tonsils.

**Abscess of the Tonsil.**—In opening abscesses of the tonsil and of the fauces great care should be exercised not to invade the tissue too deeply and endanger the internal carotid. Therefore, attention to the anatomy of the tonsil and its environments is important (page 575). The blade of a scalpel, well guarded, except at the point, with adhesive plaster or with sterilized gauze, is often employed for making the incision (Fig. 734, *g*).

### OPERATIONS ON THE TONGUE.

It is often necessary to remove the tongue in part or entirely on account of hypertrophy and malignant or other growths of its structure. The elements of danger in removal of the tongue relate to hæmorrhage, which is increased by the difficulty in catching the bleeding points, and to the danger of blood entering the larynx, both of which are emphasized by loss of command of the patient. The arteries supplying the organ are the dorsalis linguæ, ranine, and branches from the ascending pharyngeal. The ranine, the principal branch, runs along the under surface of the tongue from the base to the apex. The facial and sublingual arteries are not endangered unless the floor of the mouth is operated on in conjunction with the tongue. It should be remembered that the vessels on either side of the organ do not often communicate freely with each other, and consequently ligaturing of the lingual artery of one side will permit of free incision on that side with but trifling hæmorrhage. The buccal, sublingual, and submaxillary glands are closely associated with this organ in a surgical sense.

The principal danger from bleeding arises from division of the lingual arteries. The situation of the hæmorrhage is much more disturbing than the amount. Similar sized vessels divided elsewhere in the body would scarcely cause the least apprehension. Bleeding, however, can be prevented by ligature of these vessels in the neck (Fig. 218), or controlled for the time being by firm pressure upward on the floor of the mouth by the thumbs of an assistant, together with drawing the base of the tongue forward by means of the finger hooked over it. Not only do these manipulations control hæmorrhage, but also fix the floor of the mouth so that the bleeding points can be better seen and more quickly caught.

*A method has been recommended by Langenbeck* to control the hæmorrhage when but half or two thirds of the anterior portion of the tongue is to be removed by cutting.

A long, well-curved needle, armed with a strong ligature, is entered at the left of the median line of the tongue, behind the portion to be removed,

and passed through to the right side and under surface of the organ, so as to carry the ligature beneath the branches of the lingual artery at this situation. The ligature is then carried through the right border of the tongue and firmly tied. A similar procedure is repeated on the opposite side of the tongue. These ligatures can be used also to draw the tongue forward during operation. The late Dr. Howe, of this city, devised a "safety-pin clamp" with which he proposed to control the hæmorrhage by passing the pin above the arteries and screwing the clamp into position against the intervening tissues.

The danger of blood entering the air passages can be obviated by turning the head forward and to one side. In fact, when the head is thus placed, and the mouth widely opened, the arterial jets will escape through the latter, and thus reduce the active bleeding in the mouth to a minimum. The important desiderata are having the patient and the tongue under complete control, the dangers from hæmorrhage are then insignificant.

*Preliminary Laryngotomy.*—Preliminary opening of the larynx or trachea, together with tamponing of the pharynx, are wise measures in those instances in which careful, deliberate, and unobscured division of the tissues is needed for the purpose of suitable removal of the disease. In extended removal of the tongue and in operation on the floor of the mouth these measures find their greatest use. If there be no fear of infection at the seat of the operation, the tube may be removed as soon as the procedure is completed. Otherwise it should remain until healthy repair is established. In tamponing the pharynx with a sponge, or by other means, to prevent the entrance of blood, the tongue should be drawn well forward at the time of introduction so as to permit complete closure of the pharynx without interfering with the necessary manipulation of the organ for the arrest of hæmorrhage, etc.

Before operation, the mouth, the growth, and the teeth of the patient should be repeatedly and thoroughly cleaned by the frequent and free use of an antiseptic solution. Irregular and loosened teeth and dental asperities should be removed at the time of operation, and every care should be taken to provide for the operation field aseptic cleanliness.

**Excision of the Tongue.**—The tongue may be removed with the *knife*, *scissors*, *galvanic cautery*, *écraseur*, or *ligature*. The last method and the galvanic cautery method should be excluded, as the greater length of time required and the greater pain caused by the latter, and the greater dangers from hæmorrhage and from sepsis of the former, unfit them for use. If the diseased portion be small, it may be taken away by the incision best calculated to accomplish the object, since it is a bad plan to secure symmetry at the expense of future safety. *If hypertrophy involve the apex, or if a tumor be located at this situation*, either condition can be treated by removing a V-shaped piece in the following manner:

*The Operation. V-shaped Incision.*—Anæsthetize the patient; place him in a suitable position in a strong light with the mouth well opened by a special gag, or any proper instrument, forced, with a string attached, between the posterior molars. If the patient be in the recumbent posture turn the head to one side, so as to collect the blood in the hollow of the cheek; pass

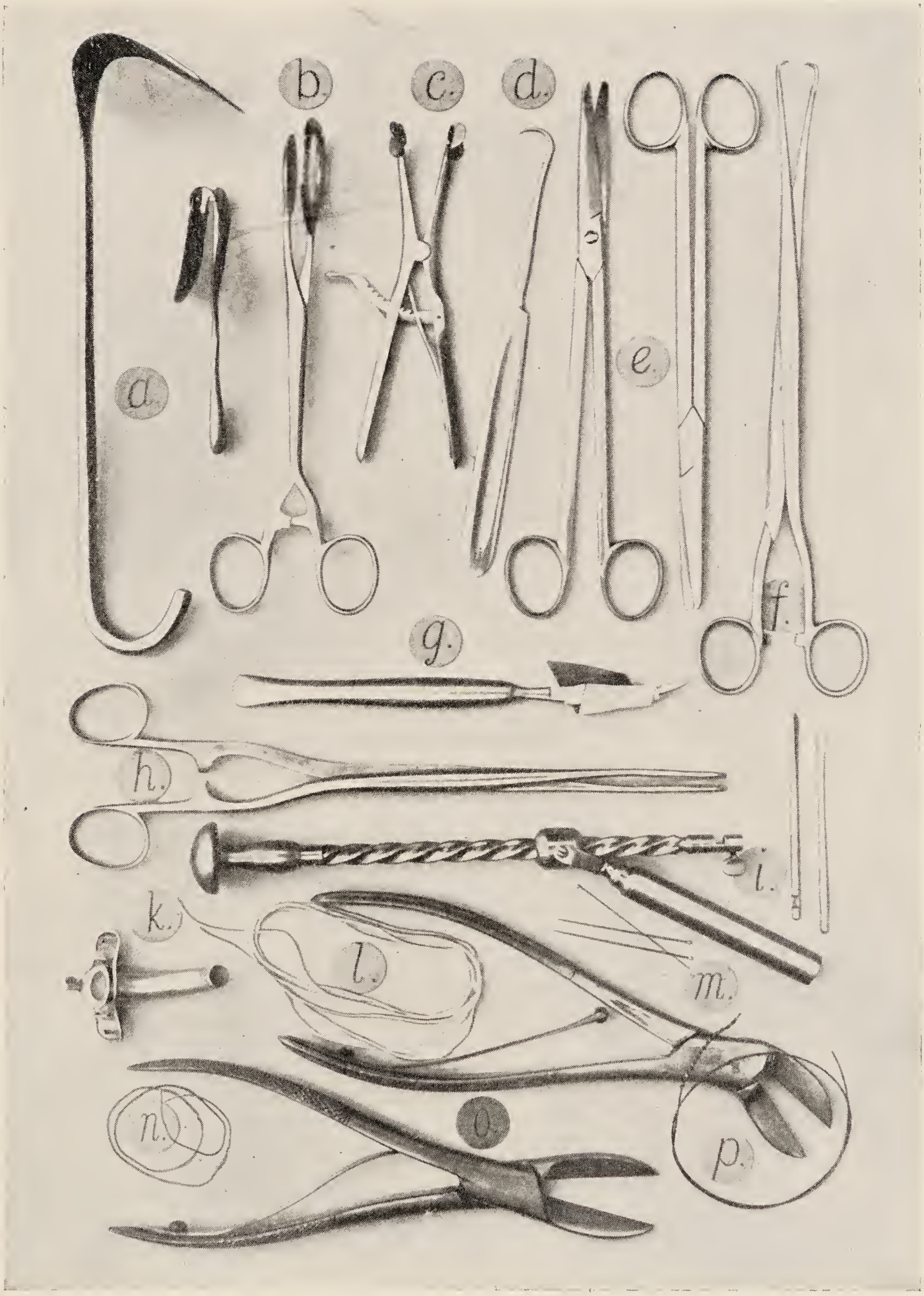



Fig. 734.—Instruments employed in operations on the tongue, tonsil, and pillars of the fauces.

*a*. For retraction of cheek. *b*. Tongue forceps. *c*. Mouth gag. *d*. Tenaculum. *e*. Curved and blunt-pointed scissors. *f*. Volsella. *g*. Bistoury guarded with adhesive plaster. *h*. Sponge forceps. *i*. Bone drill. *k*. Trachea tube. *l*. Traction loops. *m*. Hare-lip pins. *n*. Stout wire. *o* and *p*. Curved and straight bone-cutting forceps. Scalpels, forcipressure, ligatures, wipers, etc., should be had in abundance.

a stout ligature through each side of the tongue, just outside of the intended site of the apex of the V incision; then loop the ligatures and give each to an assistant with instructions to pull the tongue forward; seize the tip of the tongue with a forceps, or with the thumb and finger, and with a sharp-pointed, narrow-bladed knife transfix the organ posteriorly from below upward in the median line, thus locating the point of the V, and cut outward

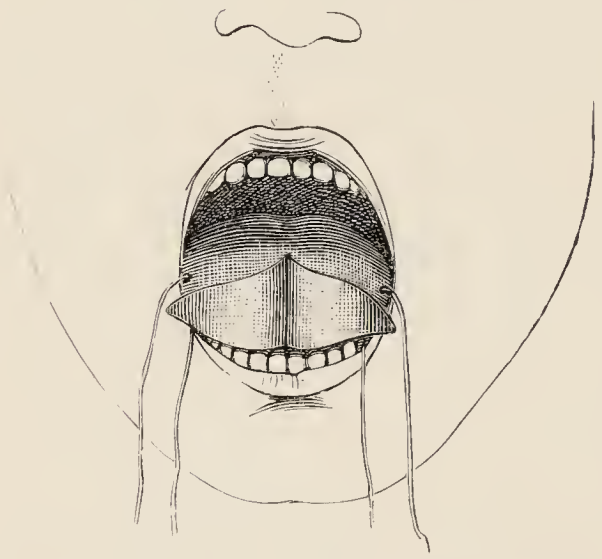


Fig. 735.—Removal of V-shaped piece.

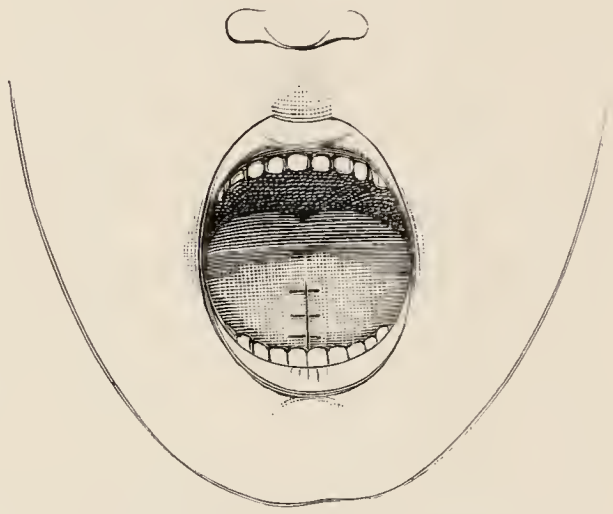


Fig. 736.—Flaps united.

and forward through one border of the tongue. Check the points of severe hæmorrhage with forceps; make the division on the opposite side in a reverse direction from the border—backward—to join the site of commencement of the first incision (Fig. 735). Ligature the bleeding points and unite the flaps by sutures in the usual manner (Fig. 736).

**Hypertrophy of the Tongue** (Fig. 737).—Hypertrophy of the tongue involving its entire structure, can be treated by the removal of a V-shaped piece in the manner just described, thus shortening the transverse diameter and diminishing the length. The flaps are then united, and, after union has taken place, the thickness of the tongue can be diminished in the following manner: A strong ligature is passed laterally through the organ near to the base, by which the tongue is drawn forward and held, while a wedge-shaped piece is removed by lateral transfixion in a longitudinal direction, begun midway between the upper and lower surfaces of the organ as far back as possible. The under flap is made by cutting downward, outward, and forward through the under surface of the tongue; the upper by division of the tissue above the last incision. The bleeding points should be ligatured and the flaps united with sutures.



Fig. 737.—Hypertrophy of the tongue.

**Half of the organ** can be removed through the mouth by first ligaturing the lingual artery corresponding to the side of operation, after which two

long, stout ligatures are passed through the tongue near the tip, one on each side of the median line, by means of which the tongue is drawn forward and upward; the frenum and the mucous membrane beneath the tongue are cut with scissors back to the base of the organ; the tongue is then divided in half from before backward with a knife or scissors; its deeper tissues are separated by tearing with the finger or the handle of the knife, and the portion to be removed is finally severed with scissors. The remaining half can be removed in a similar manner.

*The Comments.*—The contention on the part of some surgeons that the entire tongue should be excised when removal of half of the organ appears needful, has many strong and, it seems to me, wise objections offered to the practice. Half of the tongue, although deformed by healing, still has remaining, in a crippled state, the functions that characterize the organ in health, such as speaking, swallowing, tasting, etc. The moral effect on the patient of a proposition to remove the entire organ at the outset will too often lead to a rejection of the operation, thereby causing delay which may render unserviceable any operative procedure. Finally, if removal of but half of the organ affords only temporary respite, the remainder can then be taken away with no greater danger than that attending the removal of the whole in the first instance. *Hueter* suggests that, in excision of the anterior portion of one side of the tongue, the gap be closed at once by using as a flap for that purpose the apex of the remaining portion. The advantages that may follow this practice are measured by the comparative differences resulting from prompt union with a shortened organ and those of one crippled by the cicatricial influences of prolonged healing. Hueter's suggestion in this regard is not often followed.

**The Removal of the Entire Tongue.**—The removal of the entire tongue can be done through the mouth, beneath the inferior maxilla, by division at the lower jaw either at the symphysis or at one side of it, or through the cheek. It can be removed through the mouth by means of the *knife*, the *scissors*, the *galvano-cautery*, (?) and the *écraseur*.

*The Operation through the Mouth.*—Put the patient thoroughly under the influence of an anæsthetic at the outset, as afterward only partial insensibility is desired; gag the mouth, and support the head so that the blood will escape externally rather than into the pharynx. Pass a stout thread through the tongue at the juncture of the middle and anterior thirds; draw the organ forward and upward with the thread, and detach it with scissors from its connections with the jaw and anterior pillars of the fauces; divide the muscles of the tongue with strong, straight, blunt-ended scissors back to near the larynx, as closely to the under surface as the disease will permit. The glosso-epiglottidean folds are now brought under control by passing a long ligature through each fold. These ligatures are allowed to remain *in situ* in order that the floor of the mouth may be drawn forward by them in the event of secondary hæmorrhage or difficult respiration. The excision is then completed and all bleeding points are checked.

*The Comments.*—The frænum linguæ and the anterior pillars of the fauces should be completely and promptly divided so as to permit a free withdrawal

of the tongue from the mouth. *Whitehead* advises that the muscles of the tongue be rapidly and boldly cut, irrespective of other than arterial hæmorrhage, as the oozing will be promptly checked by control of the various arteries. With previous study and present caution these arteries can be caught and tied or twisted before being severed, after which the operation is promptly completed without further troublesome hæmorrhage. A preliminary tracheotomy is advisable in those cases in which extensive wound surfaces and troublesome hæmorrhage are anticipated. Infective pneumonia is obviated in the former, and the entrance of blood to the pharynx is prevented in the latter instance.

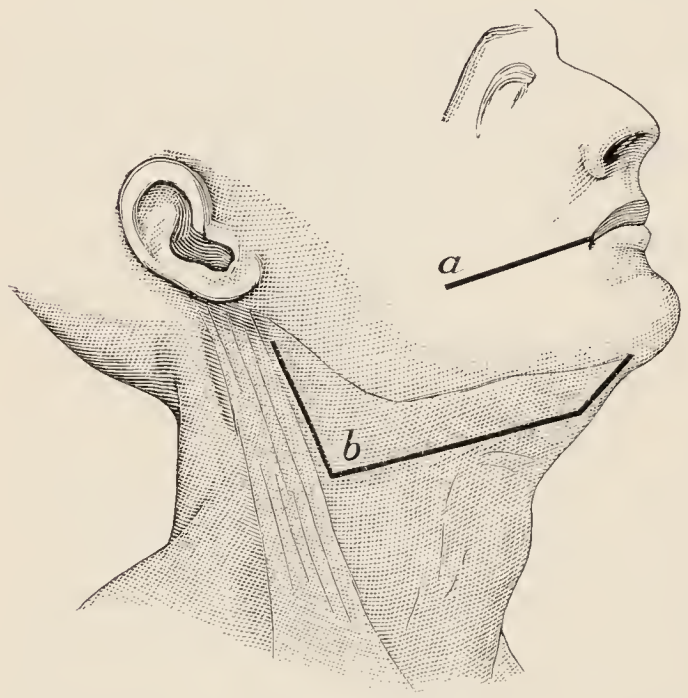



FIG. 738.—*a*. Jaeger's incision. *b*. Kocher's incision.

The ligaturing of the lingual arteries beneath the hyoglossus muscles before the employment of the scissors for removal of the tongue simplifies the operation exceedingly, as then the dangers and annoyance of present or prospective hæmorrhage are largely obviated. Now and then a dorsal lingual branch requires attention. The author has, however, noted but one instance of this kind in his own practice. Nor is this all, for the ligature of these vessels affords opportunity for the removal of the lymph glands associated directly with the affected part of the tongue, whether they are diseased or not, a measure of far greater importance in our opinion than that of ligature of the vessels. In fact it is our practice, and we believe that it should be made the first step of operative endeavor, to remove these glands, tying the lingual or not as may then seem wise.

*The After-treatment.*—Wash the floor of the mouth cautiously with a solution of biniodide of mercury (1 to 1,000), dry it, and, if desirable, paint the raw surface with the antiseptic varnish of Whitehead, which is compounded by substituting for the rectified spirits in the compound tincture of benzoin a mixture of nine parts of ether and one of turpentine saturated with iodoform. Before using the ether add one part of turpentine to ten of that fluid. The mixture dries quickly and remains as a firm coating for twenty-four hours. Gauze packings are regarded as objectionable by some, as they become quickly saturated with saliva. Treves makes "no applications of any kind" other than antiseptic solutions.

*Kocher's Method.*—Kocher recommends the following plan if the floor of the mouth and contiguous glands, and even the pharynx be involved along with the tongue: After a preliminary laryngo-tracheotomy and thorough cleansing of the parts, a triangular flap is made, with the base upward, its lower boundaries corresponding to the course of the digastric muscle, and its apex being at the point of connection of this muscle with the hyoid bone (Fig. 738, *b*). The posterior incision may also be made from the apex

directly to the anterior border of the sterno-mastoid muscle, thence upward along this border to the angle of the jaw, thus affording a greater space than is secured by the former line of incision. This flap covers the region of the jaw and neck occupied by the facial artery and the submaxillary glands posteriorly, and the lingual artery and the sublingual glands anteriorly. The flap is dissected up, the arteries are tied, and the glands are removed. This exposes the side of the base of the tongue and the back part of the floor of the mouth to easy inspection and manipulation. The larynx and pharynx are then protected from the entrance of blood by a large sponge, to which a string should be attached, and the myo-hyoid muscle is divided close to the jaw, exposing the tongue and mouth freely. The organ is now drawn through the opening, split, and the half of it on the side corresponding to the flap is removed, including, if necessary, the floor of the mouth, pillars of the fauces, and pharynx, down to the hyoid bone. The remaining portion can be removed in a similar manner through a triangular opening on the opposite side or through the primary opening, if the extent of the disease will permit. As before remarked, the operation which involves the bone and soft parts around it results less favorably than when the tongue is removed through the mouth by the methods described.

*The Comments.*—The lingual artery at either side may be tied before the flaps are turned up, or they may be ligatured afterward, as suits the desire of the surgeon. If the entire tongue be removed at one side, the lingual artery of the opposite side should be tied before the removal.

*The After-treatment* consists in keeping the mouth well cleansed, while to the raw surfaces iodoform and iodoform gauze or other suitable antiseptic dressings are applied. The tracheotomy tube should not be removed until all dangers from inflammation and from infective pneumonia due to the discharges are ended.

**The Removal of the Tongue with Division of the Jaw** does not offer the chances of success secured by the preceding method.

*Sédillot's Method.*—Beginning at the median line of the lower lip, divide the soft parts vertically downward to the hyoid bone (Fig. 739, *a*); extract a central incisor tooth and drill a small hole through the body of the lower jaw at either side, a quarter of an inch from the median line; divide the jaw in the median line vertically or irregularly—the latter affords opportunity for a more substantial subsequent coaptation; pass a strong ligature through the tongue and separate the bony fragments, thus exposing to view the floor of the mouth. Divide the mucous membrane at its connection with the jaw, also the genio-hyoid and genio-hyoglossi muscles; draw the tongue forward and sever the remaining attachments carefully with scissors, securing the ranine vessels before their division. The tongue may be either removed entire or split and each half removed separately, as before described. Unite

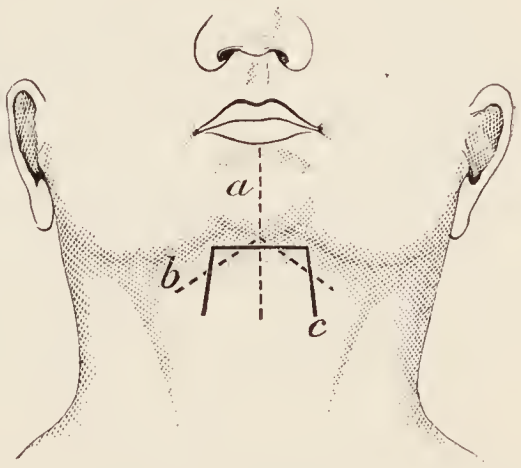



FIG. 739.—*a*. Incision of Sédillot, Roux, Syme. *b*. Regnoli's incision. *c*. Billroth's incision.

the jaw with silver wire; drain the wound from the lower angle; fortify the line of junction of the jaw with an interdental splint (Fig. 743); unite the stump of the tongue to the sides of the mouth and maintain thorough cleanliness by the frequent employment of antiseptic solutions.

*Jaeger's Method.*—Jaeger divided the cheek, from the angle of the mouth back to the anterior border of the masseter muscle (Fig. 738, *a*), and approached the diseased tongue in this manner. This measure is serviceable in instances in which the disease is located far back on the tongue, and in which the anterior pillar of the fauces is invaded, also in the event of inefficient light, severe hæmorrhage, an uncontrollable patient, or a limited separation of the jaws. If scarring be of special significance, other means of attainment of the objects should be considered.

*The employment of the écraseur*, as practiced by Mr. Baker, is a satisfactory means of removing the tongue.

*Baker's Method* (Écraseur).—Pass through each side of the tongue, one inch from the extremity and half an inch from the median line, a strong silk ligature, which is firmly tied and looped; the operator, holding one loop while the assistant holds the other, causes the tongue to be drawn forward, and then with a blunt-pointed scalpel, aided by the fingers, splits the tongue in the median line back to a point one inch behind the cancerous growth; arrest hæmorrhage, draw the diseased half still farther forward, sever the muscular and mucous connections at the symphysis, and with sharp-pointed scissors divide the mucous membrane backward along the lower jaw to one inch behind the site of the growth. Free the diseased portion of the organ from its attachments so as to readily permit the application of the écraseur and the division of the segment at a point as far as possible from the growth; pass two strong, blunt-pointed curved needles through the tongue far behind the seat of the disease, and adjust the loop of the écraseur around the segment behind and below them, so as to cause it to pass wide of the disease at the line of severance. Baker employed a whipcord loop (Fig. 740) with a moderate-sized instrument, curved somewhat on the flat at the lower end. Vessels which may remain unsevered after tightening the loop are ligatured and divided, and the nerves are severed close to the stump. If necessary, the remaining half of the tongue is treated in a similar manner. The instrument can be applied to the tongue through an opening made behind the symphysis, if the surgeon chooses, although with no practical advantage.

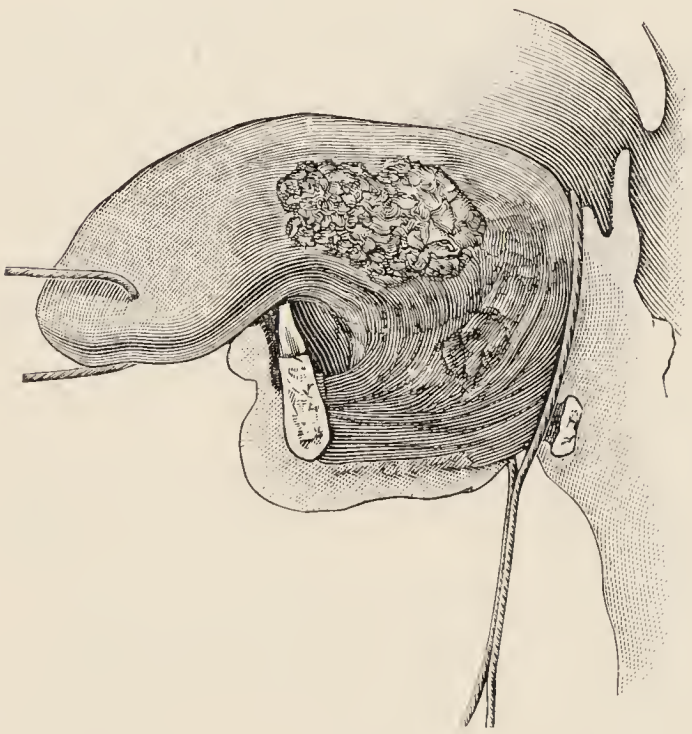


Fig. 740.—Whipcord loop applied.

*The Precautions.*—As the loop is tightened around the tongue, care must be observed to prevent it from slipping forward nearer to the seat of

the disease, which is liable to happen notwithstanding the restraining influences of the transfixion needles and of the shallow grooves made in the soft parts for the lodgment of the loop. Since the nerve and the vessels often escape the effect of the loop, the loop should be withdrawn carefully, the nerve cut, and the artery caught and tied to avoid embarrassing hæmorrhage.

*Regnoli's Method.*—The operation devised by Regnoli affords easy access to all portions of the tongue, except its base, and also furnishes good drainage, but creates a large and somewhat dangerous wound.

*The Operation.*—An angular or crescent-shaped incision is carried along the base of the lower jaw (Fig. 739, *b*) extending between the anterior borders of the masseter muscles, avoiding the facial arteries. A vertical incision is then made from the center of this to the median line of the hyoid bone. The flaps are reflected, the mucous membrane, the attachments of the lingual, hyoid, and digastric muscles divided from the inner surface of the lower jaw, and the tongue is freed laterally from the anterior pillars as in other methods. The tongue is then drawn through the opening and severed by the knife or scissors, the bleeding points being secured as fast as they appear. The flaps are united, the wound is drained, and the remaining raw surfaces are allowed to heal by granulation.

*Billroth* made a somewhat curved submental incision (Fig. 739, *c*) only, and extended it at either side so as to permit ligature of the lingual arteries and removal of the infected glands before extirpation of the tongue (Fig. 741).

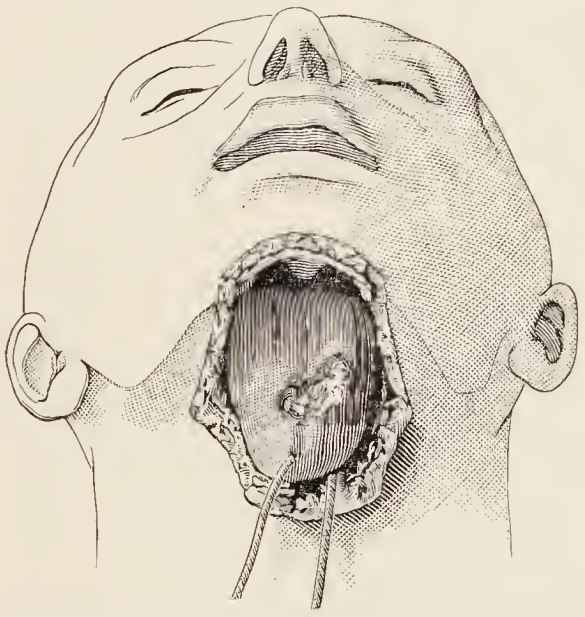


FIG. 741.—Tongue exposed through Billroth's submental incision.

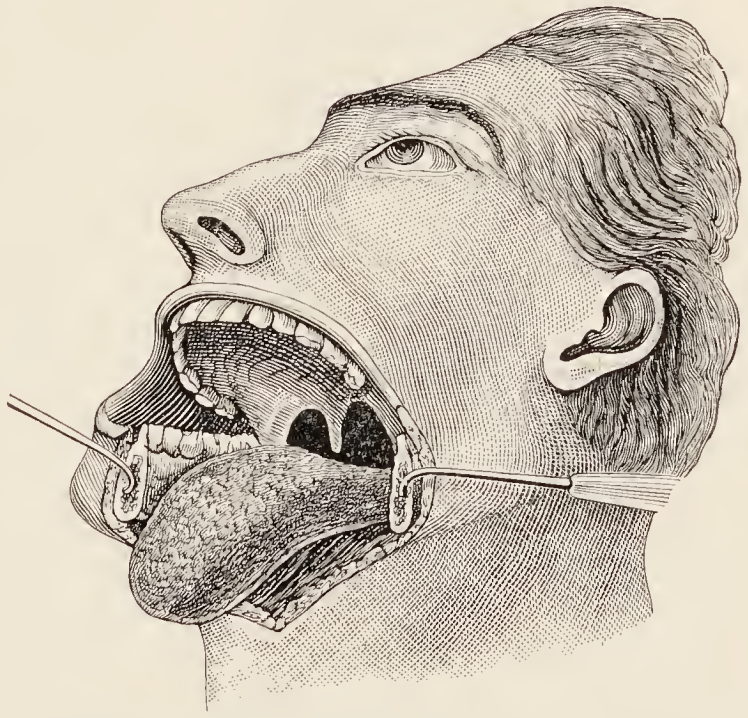


FIG. 742.—Langenbeck's incision. Floor of mouth involved.

*If the floor of the mouth were involved* in addition to the tongue, *Billroth* made an incision about one inch below the border of the lower lip, from one facial artery to the other; at either end of this incision he made a vertical one extending downward to a point about four fifths of an inch below the lower border of the inferior maxilla; at the sites of juncture of these vertical incisions with the jaw he divided the bone and turned it downward along with the soft parts, thereby affording ample room to reach the diseased parts within. After extirpation of the disease, he wired the fragments in position and closed the wound. *Langenbeck* (Fig. 742) divided the

jaw on the side of the greatest amount of disease, drew apart the fragments, excised the tongue, floor of the mouth, etc. The jaw was united as in the preceding instance. If the portion to be removed be extensive and the danger from hæmorrhage great, a preliminary tracheotomy is advisable. This measure not alone prevents the blood from obstructing respiration, but lessens the dyspnœa frequently caused by a wide separation of the jaws.

*The Choice of Method.*—In the choice of method Treves wisely presents the following propositions:

"1. The organ should be removed by cutting either with scissors or with the bistoury.

"2. The removal should, as a general rule, be effected through the mouth. (Simple removal in 202 cases, of whole or part of organ, 14 died (Butlin).)

"3. Every means should be taken to reduce the hæmorrhage to a minimum.

"4. When the floor of the mouth is involved, or the glands are extensively diseased, the excision should be carried out through the neck."

*The General Remarks.*—Cancer of the tongue causes infection of lymph glands speedily, and prompt action should be counseled in all instances. Therefore, an accurate knowledge of the nature of a morbid growth of the tongue should be quickly gained, and, too, before the employment of irritating applications. When the disease is located at the frænum it is difficult of removal and of proper estimation of the extent without first extracting two or three of the lower incisor teeth. A suitable vulcanite interdental splint constructed to fit the jaw before its division is the best agent for the retention in place of the fragments after operation (Fig. 743). It should not be overlooked that in hopeless cases the removal of the disease from the buccal cavity, even though it returns promptly elsewhere, rescues the patient from the pitiless suffering attendant on its presence in the mouth.

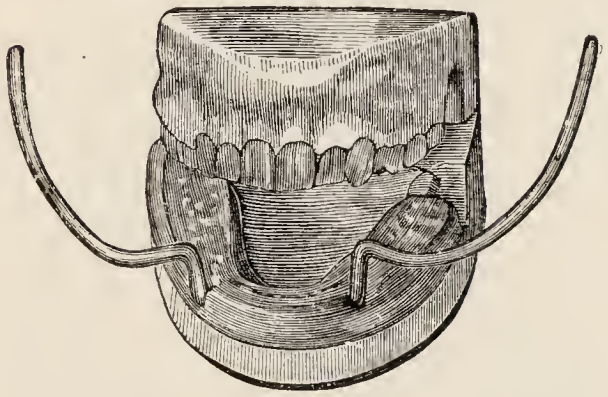


FIG. 743.—Kingsley's interdental splint of vulcanized rubber.

*The After-treatment.*—Thorough asepsis and a liberal nutritious diet are the elements of prime significance in the treatment. Rectal alimentation for the first two days, followed by the use of the stomach tube, if necessary, is very important. Abundant fresh air and cleanliness of the mouth should be secured.

*The Results.*—The rate of mortality from removal of the tongue by all of the methods described is considerable, fifty-six out of two hundred and forty-four cases having died. In one hundred and sixty-three cases of removal through the mouth attended with preliminary ligature of the linguals only, the death-rate was 12.8 per cent. In fifty-eight cases operated on by Kocher, the death-rate was about 10.5 per cent. In twelve cases done by Kocher after his own method the death-rate was 8.3 per cent. In removal requiring excision of the jaw or extensive dissections, the rate is increased five and ten per cent. In two hundred and forty cases ten per cent

reached the three-year and 6.6 per cent the four-year limit. In severe cases, when thoroughly done, the life limit is encouraging, as is shown by the fact that half of Kocher's long-lived ones were of this character. Whitehead reports 129 cases, in which, so far as could be known, 8 lived from 3 to 10 years, 17 succumbing before the three-year period (Curtis). Treves reports 34 cases of his own attended with primary ligature of the linguals, in which 3 died. Baker reports, as the result of his method, 40 cases with 5 deaths, 1 from diphtheria. Many of Whitehead's cases are early ones. The rate in removal of glands and part or whole of tongue below jaw is 5 per cent better than with division of jaw.

**Tongue-tie.**—Tongue-tie depends on an undue extension forward, either with or without an abnormal shortening of the frænum linguæ. If the condition be severe enough to call for treatment, the end of the tongue is pressed upward by passing the first two fingers beneath it, palm downward, bringing the tense frænum between them, which can be divided with a blunt-pointed scissors at a little distance from, but parallel with the palmar surface, care being taken not to sever the ranine artery.

**Ranula** (Fig. 744).—The closure of the ducts of the sublingual and other glands in this situation causes a cystic distention of them, and even of the glands themselves. If it is not possible to find and probe the duct openings, it will be necessary to evacuate the contents at the floor of the mouth below the tongue, or, if the tumor be of large size, this must be done in the median line externally, close to the hyoid bone. In either instance it may be necessary to pack the cavity with lint and liquor ferri sulphatis, or cauterize the sac with nitrate of silver or carbolic acid, and even to dissect it partially or entirely away. The use of stimulating injections, the introduction of a seton of silk medicated with an astringent or stimulant, or the division and stitching outward of a portion of the wall of the cyst, may be practiced if simpler means fail.

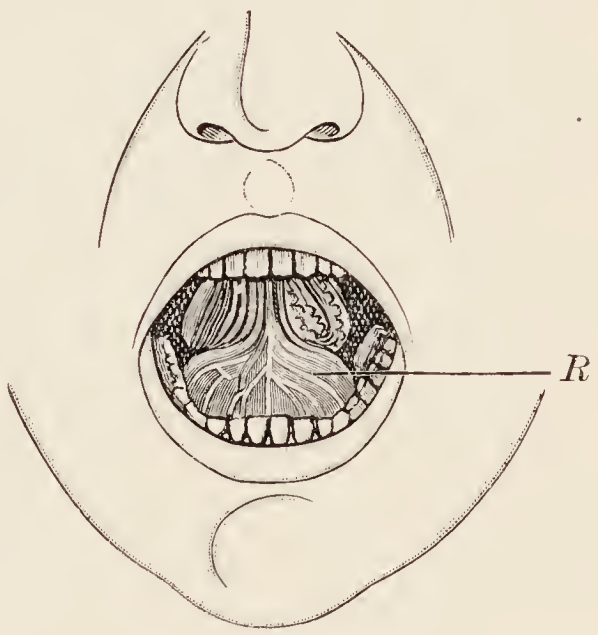



Fig. 744.—Ranula.

**Removal of Tumor of Tonsil and Pillar of Fauces.**—This operation is practiced for the purpose of removal of malignant disease of the tonsil, with or without involvement of contiguous tissues. In the simpler forms the disease can be removed through the mouth. But if the disease be extensive, and evidences of deep tissue and lymphatic involvement be noted, the approach should be made from the neck (pharyngotomy). In either instance a careful study of the important nervous and vascular relations to the diseased structure should be made.

*The Anatomical Points.*—The tonsil in health corresponds to the angle of the lower jaw. It is a vascular structure receiving branches from the facial, internal maxillary, lingual, and ascending pharyngeal arteries. The internal carotid lies at the outer and posterior aspect of the tonsil, at a distance of

about three fourths of an inch, separated from it by the muscular and fibrous structures of the pharynx, the styloglossus, and stylopharyngeus muscles. The glosso-pharyngeal nerve has a substantially similar association. The removal of the tonsil for malignant disease can be carried on through the mouth or through an incision in the neck. The former route is advisable when the growth is limited to the tonsil, and even extends to the base of the tongue, and is not attended with glandular involvement. In some instances either tracheotomy with pharyngeal plugging, or splitting of the cheek, and ligature of the external carotid, may be practiced, especially the latter, if for no other reason than that of lessening, for a time, at least, the blood supply of the diseased part.

*The Operation.*—Fix the mouth widely open with the gag and raise the shoulders so as to expose the parts to a good light; seize the diseased tonsil with forceps or tenaculum, and draw it well into the mouth, then with long, blunt-pointed scissors divide the tissues cautiously and as far away from the growth as advisable, arresting hæmorrhage with sponge pressure, torsion, etc., as it appears. If the disease has extended beyond the tonsil to the pillars of the fauces, divide the soft palate near to the median line, thence outward with scissors, and finally remove the pillars of the fauces and the tonsil by means of blunt dissection carried on with the scissors, fingers, or an instrument devised for the purpose. If it so happens that the large size of the growth interferes with the visual or manipulative opportunities of the surgeon, the growth may be reduced in size by the galvano-cautery knife at a dull red heat. Forcipressure and sponge pressure usually meet the hæmostatic requirements.

**Pharyngotomy** (Cheever's Method, Fig. 745).—Make an incision through the integument, platysma, and fascia along the anterior border of the sterno-mastoid muscle from the level of the lobe of the ear to below the level of the tumor; make a second one extending from the first along the body of the lower jaw; dissect and draw aside the flaps; avoid, if possible, the lower branches of the facial nerve; divide the stylo-hyoid, styloglossus, stylo-pharyngeus, and the digastric muscles, if need be; ligature and divide the facial artery and vein; draw the submaxillary gland forward, and the internal jugular vein and carotid arteries outward, exposing the pharyngeal wall. Introduce the forefinger into the mouth and outline the extent of the disease, aided by conjoined manipulation from without. Open the pharynx in front of the disease from without with a galvano-cautery knife or with scissors, thence passing upward, backward, and downward, circumscribing the disease widely and removing it along with the contiguous portion of the wall of the pharynx, leaving no lymphatic glands behind.

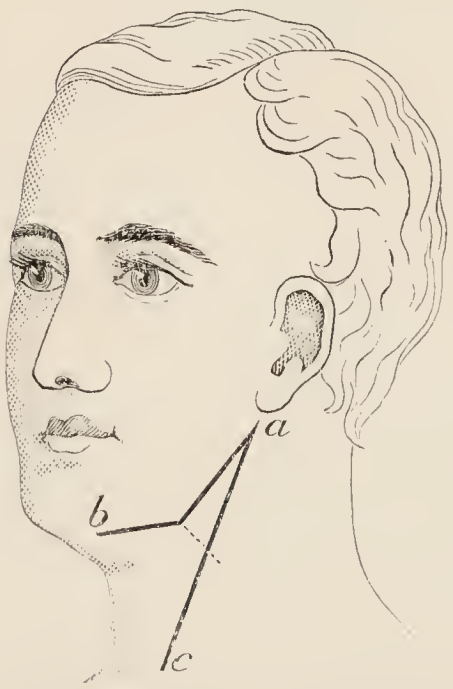



FIG. 745.—*a*, *b*, *c*. Cheever's incision. *a*, *c*. Mikulicz's incision. ----. Author's secondary incision to *a*, *b*.

*The Remarks.*—The author, in a recent severe case requiring excision of the ascending ramus of the jaw, carried the first (*a*, *b*) incision along the lower

border of the horizontal ramus of the jaw instead of in the course described above. The second incision (dotted line) was made backward and downward from near to the center of the first, and the flaps were reflected in the usual manner. On closing the external wound, the lower end of the second incision was situated admirably for the purposes of dependent drainage.

*Czerny's Method.*—Introduce a tracheotomy tube, and tampon the pharynx; make an incision from the angle of the mouth downward and outward to the anterior border of the masseter, thence downward to the level of the hyoid bone; expose and divide the lower jaw just in front of the last molar tooth; draw the fragments apart and divide the buccinator, digastric, styloglossus, stylo-hyoid, and stylopharyngeus muscles; secure the facial and lingual vessels; avoid the salivary glands, and the lingual, hypoglossal, and glosso-pharyngeal nerves. After removal of the growth the jaw is united with silver wire, and the wound is closed and dressed.

*Mikulicz's Method.*—Tracheotomy and pharyngeal tampon are employed the same as before. Make an incision from the tip of the mastoid process along the anterior border of the sterno-mastoid muscle to the greater cornu of the hyoid bone. Expose both surfaces of the ascending ramus of the lower jaw with the rugine, carefully avoiding the parotid gland, facial vessels, and external carotid artery; exsect the ramus, draw aside with strong hooks the body of the jaw, the masseter, internal pterygoid, digastric, and stylo-hyoid muscles, thus exposing the lateral wall of the pharynx at the situation corresponding to the tonsil. The pharynx is opened and the disease is removed as in the first instance. If the tissues connected with the ramus of the jaw are involved, this portion of the bone should be removed along with the diseased structures connected with it. The elevation of the periosteum at the inner surface in such cases as these is obviously as unnecessary as it is unwise.

*The General Remarks.—Treves* advises the passing of a soft catgut ligature beneath the common carotid, so that hæmorrhage can be arrested promptly in case of need, by traction on the ligature, not, however, by tying it. After operation the ligature is removed and the wound closed. If hæmorrhage be not feared, preliminary ligature of the external carotid is advisable, since this measure not only controls hæmorrhage, but likewise arrests the freedom of the circulation of the part for some time to come, and, moreover, offers no impediment to cerebral circulation. In those cases in which the external carotid is tied and the operation completed at once, infection of the wound from the pharynx may lead to cellulitis of the neck, and to secondary hæmorrhage from the external carotid at the seat of the ligature. Therefore, in our last case of this kind, the wound was packed with iodoform gauze for three days before the disease was removed. During this time reparative closure of the interstices of the entire wound had taken place, and but a very limited suppuration followed. A longer time than this can be taken in many instances. It is essential for final cure that the lymphatic glands be removed irrespective of the appearance in them of infection, as it is a well-established fact that

these glands may be infected without causing an appreciable increase in size. The glands and the associated connective tissue should be dissected away together, thus securing the removal of infected glandular and other lymphatic structures. Two wires should be introduced through the fragments of the jaw at some distance apart, especially in the posterior division of the bone, to prevent rotation of the posterior fragment, which is quite sure to happen if but one be employed. The interdental splint (Fig. 743) finds in these cases a most satisfactory use.

*The After-treatment.*—Free drainage, thorough cleanliness, and ample nutrition by means of the stomach tube are essential. The opening in the wall of the pharynx should be closed at once as far as possible with chromicized catgut. The external wound is closed; drainage and moderate pressure are applied to the surface. If an opening remain in the pharynx, it should be plugged lightly from within with antiseptic gauze to prevent infection of the wound. The patient should be got out of bed and in the fresh air as soon as practicable. He should be caused to lie on the well side during healing, to prevent contact with the raw surfaces of the buccal discharges.

*The Results.*—Late detection of the disease, with consequent involvement of the glands, renders the final outcome very unsatisfactory indeed. However, sufficiently favorable results have followed bold and extended action on the part of many surgeons to warrant the attempt of extirpation, provided proper co-operation can be secured. Bosworth reports but one cure—two and a half years—in 118 cases. *Butlin* reports 54 cases, with 14 deaths from operation; 21, alive or dead, with recurrence; 3 died from cancer elsewhere; 9 were free for more than three and 8 from one to three years. Butlin does not favor preliminary tracheotomy.

## OPERATIONS ON THE NOSE.

**Plugging of the Posterior Nares** (Fig. 746).—Plugging of the posterior nares is practiced for the arrest of obstinate epistaxis. The tampon or plug can be made of sponge, lint, or of suitable cloth, and should be of a proper size to closely fit the posterior naris of one side, which in the adult is about three quarters of an inch long and half an inch wide. The plug is made by tying a strong ligature around the middle of the selected aseptic material suitably arranged for the purpose, the ligature including within its grasp at opposite sides of the plug the loops of two other strong ligatures, which are in turn tied firmly to the primary one; the ends of the latter after tying are cut short. A plug of simpler construction than this is often employed (Fig. 746). The cannula of Bellocq (Figs. 746 and 747, *c*), with the spring withdrawn, is then carried along the floor of the nostril to the posterior wall of the pharynx, when the movable rod is projected forward into the mouth. The extremities of the loop at one side of the tampon are passed through the eye of the instrument with which they are drawn through the meatus by first returning the central rod and then withdrawing the instrument itself. The tampon is now carried into position by pulling on the strings which have their exit through the nose, aided by the finger carried behind the soft

palate. Sufficient traction is made to forcibly close the posterior naris; the strings in front are then tied around another plug similar to that already used, by which means the anterior opening is closed as well. The plug should be well carbolized before introduction, and, if need be, can be wet with an astringent solution. The plug is removed at the end of forty-eight hours by pulling downward on the strings remaining in the mouth supplemented with backward pressure by an instrument introduced along the floor of the nostril. If the cannula of Bellocq be not available, a long, flexible probe, an ordinary gum catheter (Fig. 747, *c*), or even a common wire, may be utilized in its stead (Fig. 747, *c*). Sometimes the string is carried preferably through the nostril and out of the mouth by means of the cannula, etc., or other instrument, and then attached to the plug, instead of being tied to it before the cannula is introduced.

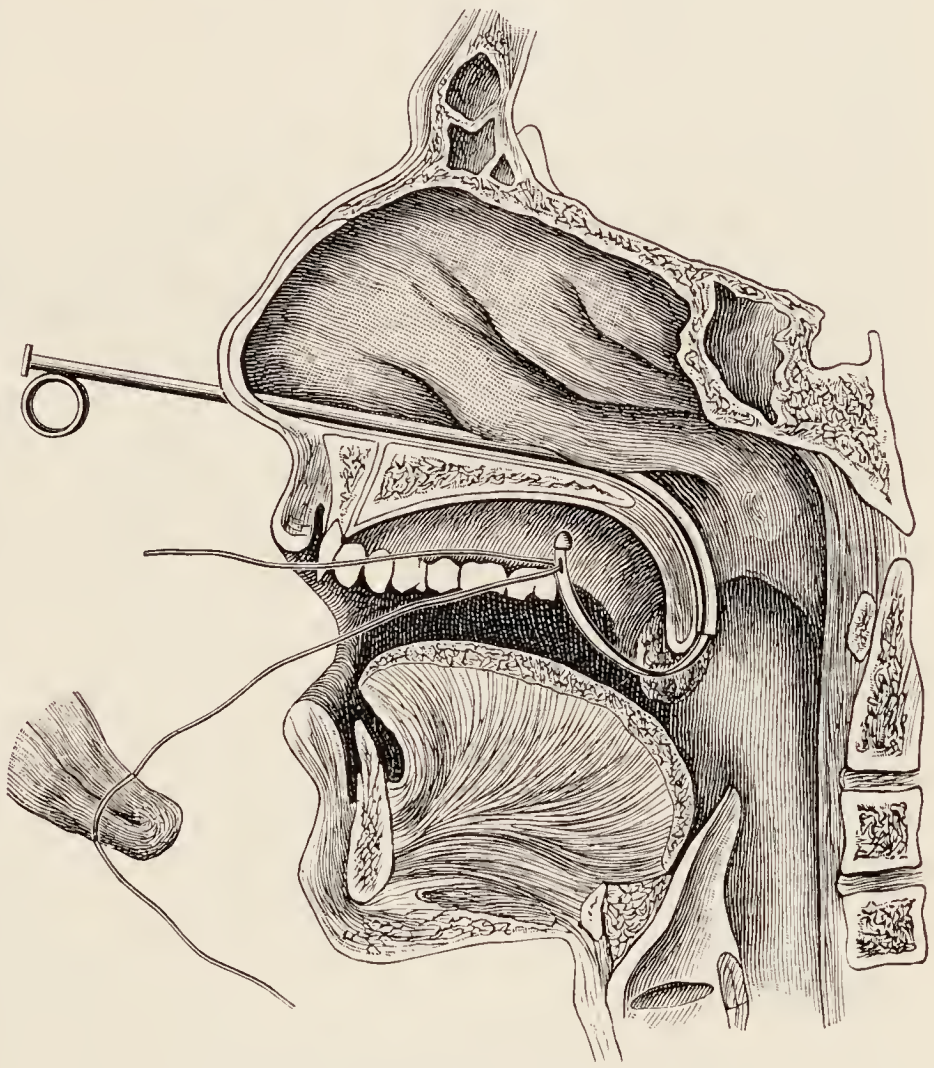


Fig. 746.—Plugging posterior nares.

*The Remarks.*—If the plug be introduced too tightly, sloughing of the mucous membrane may ensue, followed even by necrosis of the bones; also, the removal may cause quite severe bleeding. If hæmorrhage recur after removal of the plug, the nares should be thoroughly cleansed before another is introduced, to obviate the danger of sepsis, a risk that is proportionate to the length of time that the plug is allowed to remain in place unchanged.

**The Removal of Nasal Polypi** (Forceps or Snare).—If the polypus or the pedicle be small, the growth can be quite readily removed by the forceps or the snare.

If the forceps be employed, the patient should sit in a chair exposed to a bright light, with the head supported by an assistant, and, after spraying the nares with a strong solution of cocaine, the point of attachment of the growth is seized and twisted off by turning the instrument repeatedly on its long axis. *If the growth be attached to the turbinated bone*, it may be necessary to twist and pull away the bone structure before the tumor can be removed. In such a case as this, the patient should be placed in the recumbent position and with the head so turned as to cause the blood to flow from the nose instead of into the pharynx. An anæsthetic should be em-

ployed. One blade of the forceps is passed carefully beneath the turbinated bone, the other at the opposite side, and when closed firmly the bone is twisted away along with the large, and often with numerous small growths. If the growth be situated far back or hang down into the fauces, it may be detached by the finger passed behind the soft palate. If this plan fail, the tumor may be snared. In snaring, the wire loop (Fig. 747, *c*), without or with the cannula (Fig. 749), is passed along the floor of the nose and over




FIG. 747.—Implements employed in plugging nares and in removal of nasal growths, etc.

*a*. Nasal specula. *b*. Straight and curved polypus forceps. *c*. Gum catheter, Bellocq's cannula, and wire loop for plugging. *d*. Polypus snare. *e* and *f*. Extemporized tracheal anæsthetizing apparatus.

the tumor by aid of the finger. The loop is tightened and the growth severed. The growth may be strangulated by means of intertwined loops placed around the pedicle as indicated in Fig. 750. The greater length of time required and the offensive odors that often attend the removal do not commend the method.

**The Removal of some Nasal and Naso-pharyngeal Polypi.** — In addition to instruments employed in removal of nasal growths (Fig. 747) there may be also required instruments for ligature of vessels (Fig. 169); for excision of the jaw (Fig. 331); chisels and mallet (Fig. 394), and for tracheotomy and tracheal anæsthesia (pages 580 and 1084). An abundance of forcipressure, ligatures, antiseptic wipers (Fig. 66), and gauze, should be provided. If the growth be fibrous and not amenable to treatment by the previous methods, or be of naso-pharyngeal origin, it can then be exposed either by way of the nasal palatine or maxillary routes. *The nasal route* is best suited to the removal of growths limited to the nasal cavity. They may be reached by *turning the cartilaginous part of the nose aside* (Desprez).

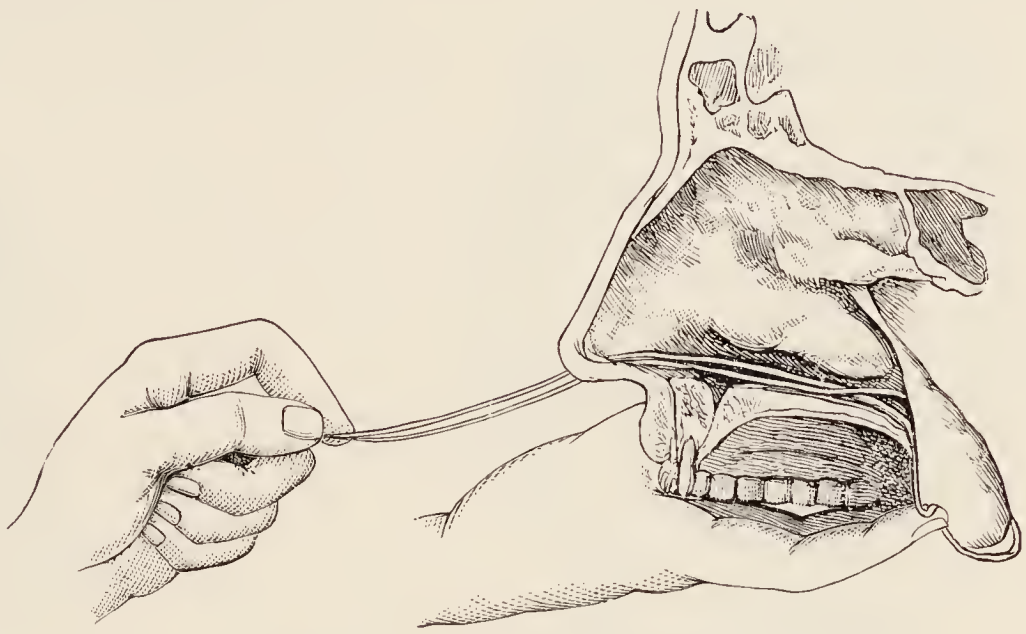


Fig. 748.—Loop guided over polypus with finger.

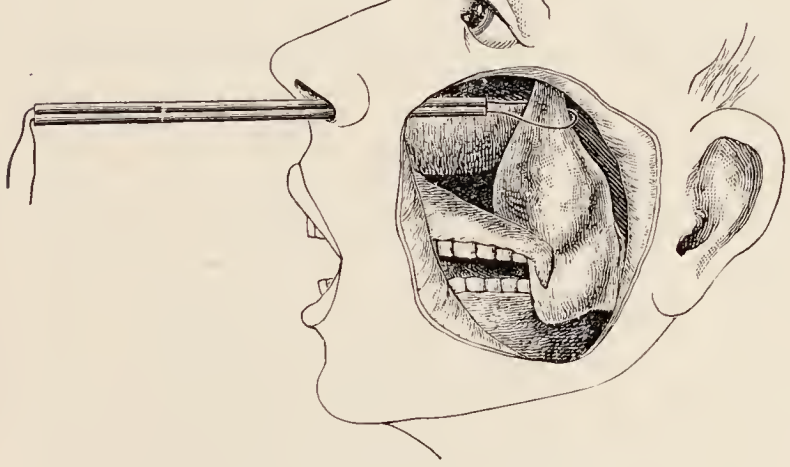


Fig. 749.—Double cannula in position.

*The Operation.*—Locate the free margin of the nasal bone; divide the skin parallel with this margin from the middle line of the nose down to the junction of the cheek and nostril, and thence cut downward, ending in the nasal orifice of the opposite side; separate the cartilaginous from the bony part of the nose by means of scissors, and the inferior attachment of the septum for the proper distance by the same means. The end of the nose is freed and turned to the opposite side, and, if additional space be required, the turbinated bones are removed. After removal of the growth, the end of the nose is replaced and united with sutures to the divided borders.

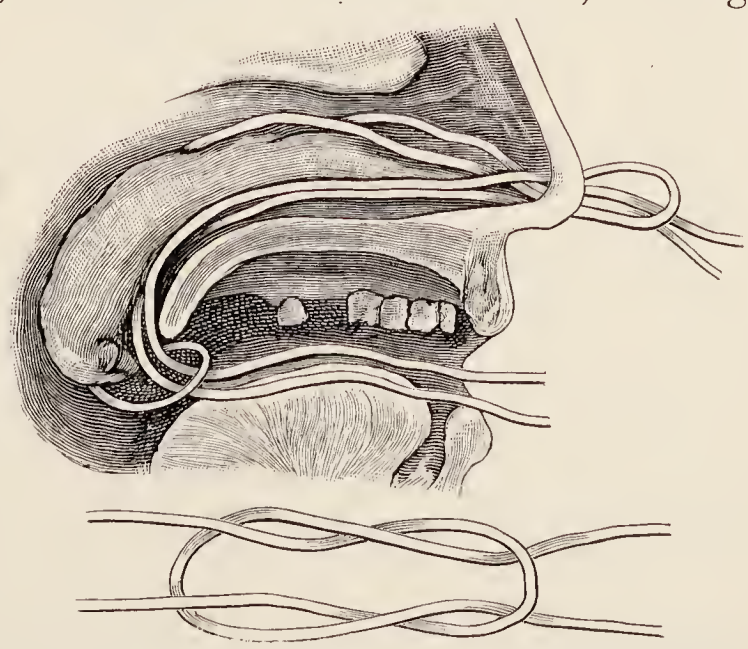


Fig. 750.—Application of loops for tying pedicle.

*Chassaignac's Method.*—Chassaignac carried an incision from near the inner canthus of one eye directly across the root of the nose to a point corresponding to that of starting, thence downward along the outer side of the nose through the alar groove across close beneath the end of the nose to the

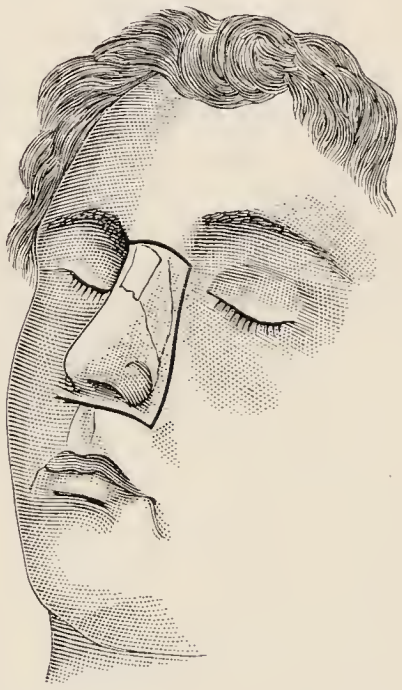


FIG. 751.—Chassaignac's method, the incision.

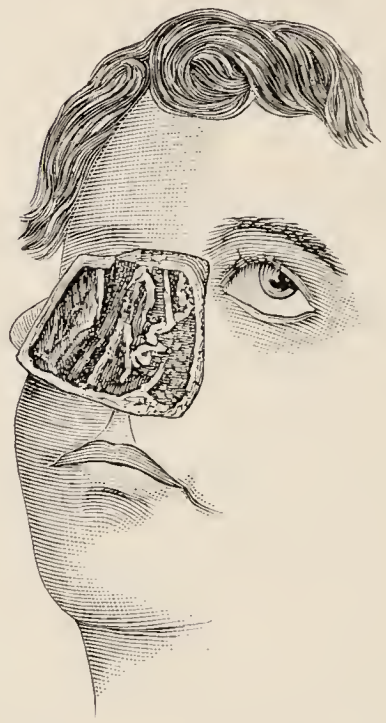


FIG. 752.—Chassaignac's method, flap turned aside.

opposite ala (Fig. 751). He divided the bones in a line corresponding with the incision of the soft parts, also the septum, and turned the nose to the opposite side, thus exposing freely the nasal cavity (Fig. 752).

After the removal of the growth, the parts are restored to their normal position and the edges of the wound united. *If this method be not deemed advisable*, the nose can be *turned downward* by making a U-shaped incision down to the bone, the convex portion of which shall cross the root of the nose between the eyes, while the arms extend downward at each side of the nose to the outer borders of the alæ (Ollier) (Fig. 753, *a*). The bones are then sawed through in the line of the incision, the septum liberated at their under surface, and the nose turned downward, so as to expose the interior of the nasal cavity to observation and manipulation. If the growth be a large one and greater space be necessary, the incision can be modified (Fig. 758, *a*), as shown by the dotted line, and the bones lying in its course sawed through, as before described, care being taken to avoid the roots of the teeth. After the removal of the growth, the parts are replaced and confined in position by sutures, dressings, etc. Naso-pharyngeal polypi can sometimes be removed by this method.

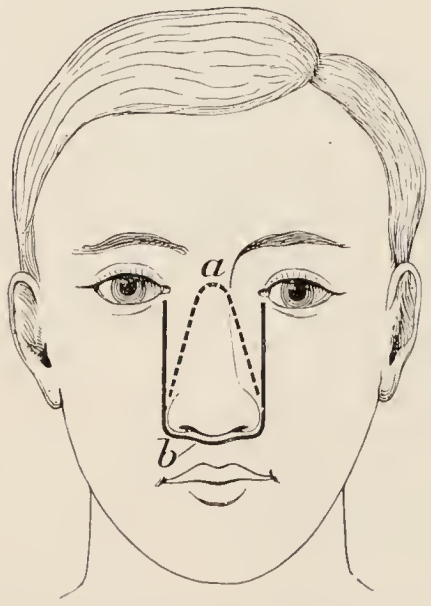



FIG. 753.—*a*. Ollier's method. *b*. Lawrence's method.

In 1873 Rouge described the following method applicable to the removal of diseased bone, obstinate polypi, and even small naso-pharyngeal growths when located well in front:

*Rouge's Method.*—With the patient's head turned to one side and the upper lip drawn forcibly upward by an assistant, the surgeon carries a curved scissors close to the bone through the space lying between the bicuspid teeth of the respective sides, severing the soft parts up to and opposite the nasal bones. At the same time the cartilaginous septum is detached from the nasal spine, thus permitting the end of the nose to be turned upward toward the forehead, thereby exposing the anterior nares to free examination (Fig. 754). After removal of the growth, the parts are restored to their normal place and held there by careful bandaging.

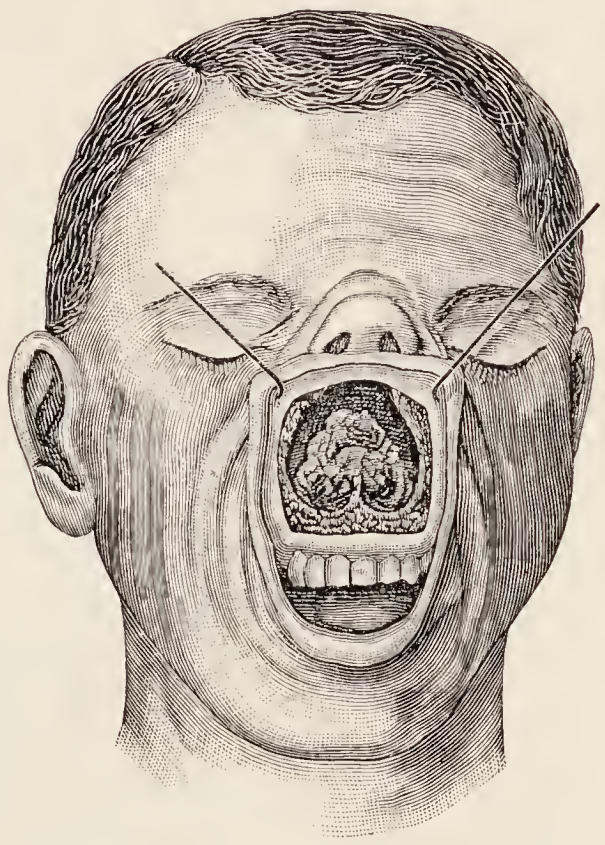


Fig. 754.—Rouge's method.

*Langenbeck's Method* (Fig. 755, *a*).—Make an incision from near to the center of the root of the nose obliquely downward and outward on the outer side of the nose and cheek to a point external to the ala nasi. Separate the upper border of the flap a short distance, leaving the periosteum; sever the alar cartilage from the nasal bone, and with bone nippers sever the nasal bone from its fellow. Also in the same manner divide the nasal process of the superior maxilla at its base through to the margin of the orbit (Fig. 756). The entire upper part of the nasal cavity can then be exposed by raising upward the quadrilateral piece of bone thus formed of both the nasal bone and process together.

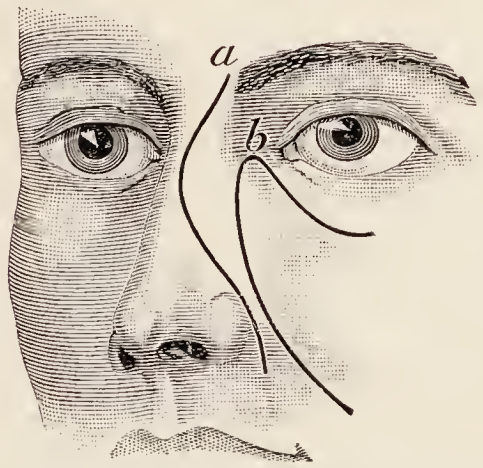



Fig. 755.—*a.* Langenbeck's method. *b.* Boeckel's method.

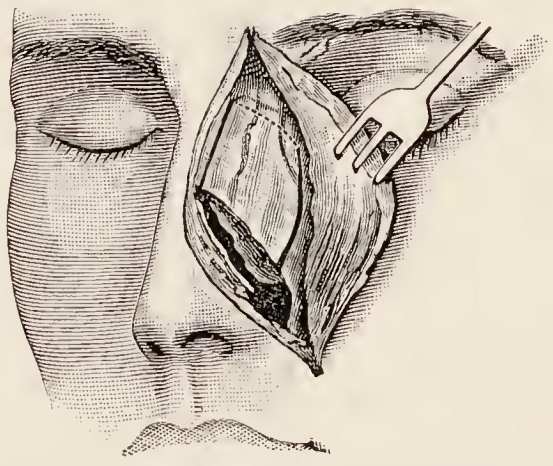


Fig. 756.—Langenbeck's method, flap turned aside.

After the tumor is removed the bone flap can be returned and fastened in its proper position.

*Lawrence's Method* (Fig. 753, *b*).—From a point just internal to the lachrymal sac, make an incision along each side of the nose to the junction of the ala with the lip. Sever the nasal bones and the nasal processes of the superior maxillæ with bone forceps, thus opening into the nasal cavity. Divide the septum and turn the nose upward.

*The Comments.*—Rouge's method leaves no scar and the parts are readily adjusted without sutures. The nose, however, should be supported in

proper shape until union takes place. The amount of room provided by these operations is limited, therefore a careful determination of the connections of the growth must be made before operation, to avoid unwise or needless mutilation.

*The palatine route* is suited for the treatment of more difficult cases than is the nasal one. Naso-pharyngeal as well as nasal growths are approachable through this channel of procedure.

*Nélaton's Method* (Fig. 757, *a*).—Make an incision in the median line through the uvula and soft palate down to the bone (*a*); continue it forward along the posterior half of the hard palate; two other incisions, one on either side, are now carried obliquely outward from the anterior extremity of the first to the respective alveolar processes; these flaps, including the periosteum, are reflected outward with a rugine; the hard palate is perforated and cut away; the periosteum and mucous membrane of the floor of the nose are turned aside, the septum is removed if necessary, the tumor exposed to view and excised. The periosteal flap of the hard palate should be returned to the normal position and stitched in the usual manner. The cut through the soft palate can be joined then or subsequently, accordingly as the operator desires. If the growth be a small one, but one side of the hard palate need be attacked.

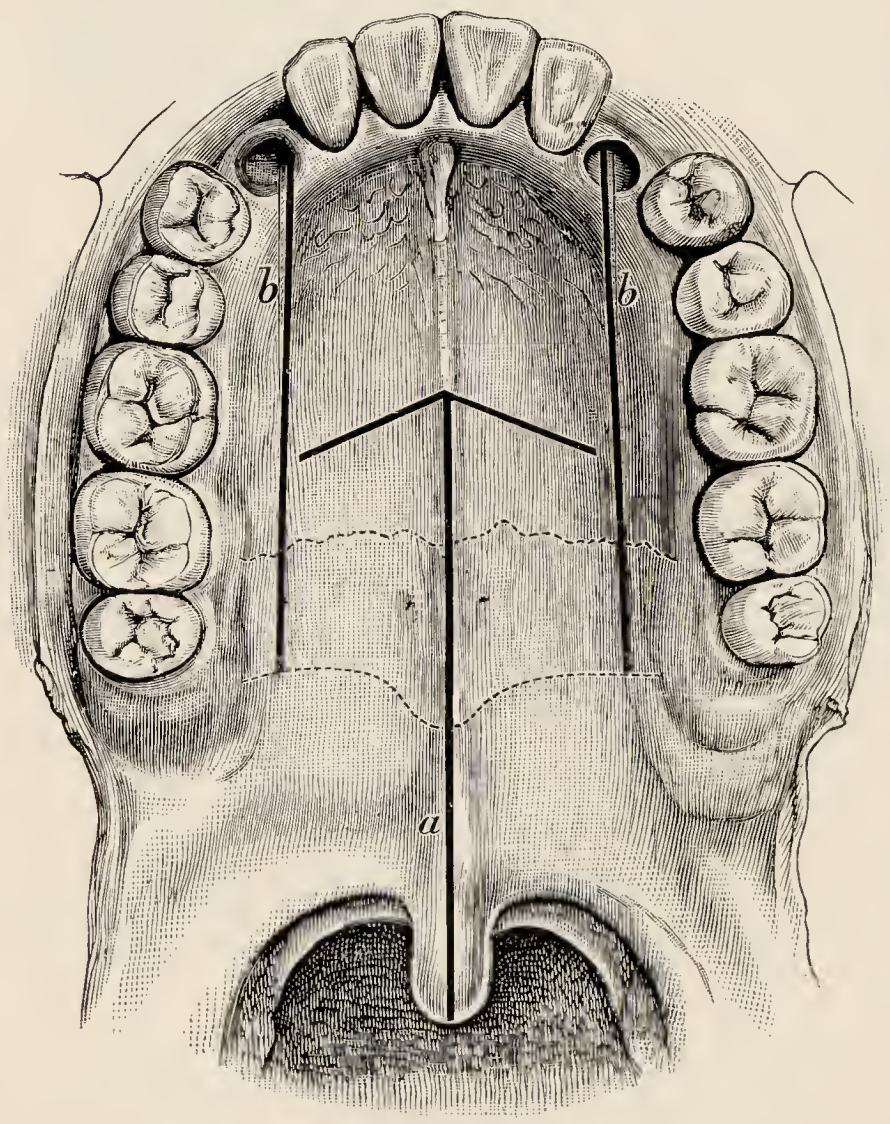



Fig. 757.—*a*. Nélaton's method. *b*. Chalot's method.

*Chalot's Method.*—Divide the gingivo-labial fold and separate the upper lip from the bone at a point corresponding to the anterior nasal spine, thus opening into the nasal fossæ in front. Draw the canine teeth, open the mouth widely, and make an incision down upon the under surface of the hard palate at either side close to the alveolus, beginning at the empty socket of the canine tooth, and terminating at the posterior border of the bone (Fig. 757, *b*, *b*); divide the alveolus and hard palate at either side in the line of incision with chisel and mallet; separate the bony flap thus formed from its connections with the vomer and nasal mucous membrane; displace it downward and backward into the mouth, the velum acting as a hinge; remove the growth; restore and fasten the bone flap in place with wire sutures. This procedure is ingenious and effective except when the growths are large and

located at the vault of the pharynx. The degree of hæmorrhage in this operation is an important item, and suggests the advisability of tracheotomy and a pharyngeal tampon as wise preliminary measures, especially as the presence of the bone flap will impede the manipulations of the surgeon.

*Annandale's Method.*—Expose the anterior nares as advised by Rouge (page 583); divide the bony septum at its connections with the maxillæ; open the mouth widely and make an incision in the median line of the hard palate down to the bone; remove a middle incisor if need be, and divide the alveolus and hard palate in the median line with a small saw introduced through the nose. The soft palate is not disturbed unless the size or position of the morbid growth calls for it. The maxillæ are pried apart or drawn asunder with hooks, if required, carefully avoiding displacement of the nasal bones by severing their connections with the nasal processes of the superior maxillæ, if called for, the tumor is exposed and removed with forceps, scissors, scoops, etc. Thorough disinfection, and packing with antiseptic gauze follows the removal, succeeded by restoration and wiring of the bones in the proper position. The soft palate should be closed at the same time if the condition of the patient does not contra-indicate it. This operation offers the most room of any by this route, with no loss of structure or resulting deformity.

*The maxillary route* is selected when the size and nature of the growth render the preceding ones dangerous on account of the hindrance due to the limited space available for operation. A preliminary tracheotomy is advisable if the tumor be large, of broad origin, or unusually vascular.

*Boeckel's Method.*—Make an incision down to the bone from near the root of the nose along its side to the groove of the nostril and cheek, thence in a curved direction outward and backward on the cheek to a point vertically below the middle of the orbit (Fig. 755, *b*). A second incision, beginning at the upper end of the first, is carried outward along the lower margin of the orbit down to the bone; raise the flap with the periosteum from the bone with a rugine or periosteotome, exposing the lower portion of the nasal bone and the entire width of the nasal process of the superior maxilla, carefully avoiding the lachrymal sac and the infra-orbital nerve; define the bone flap (Fig. 338, D) with chisel and mallet, commencing at the inner border of the infra-orbital canal and going vertically downward to opposite the floor of the naris, thence inward to the naris itself; then divide the bone in front of the lachrymal sac, the nasal process its entire width, and finally cut downward and inward through the lower portion of the nasal bone by similar means, the chisel going into the nose throughout the entire course of the bony incision. Remove the bone section, thus exposing the nasal cavity, which exposure can be still further increased by removal of the turbinated bones. After removal of the growth the opening is closed by returning and suturing in place the periosteal flap.

*Langenbeck's Operation.*—Make a slightly curved incision with the convexity downward, extending from the ala of the nose to the malar bone, and thence as far backward as the middle of the zygoma. A second incision is made, beginning near the center of the root of the nose, and, passing along

the inferior margin of the orbit, to join the former near the middle of the malar bone (Fig. 758, *c*). These incisions should extend down to the bone; the soft parts, however, are not to be raised, with the exception of the periosteum of the floor of the orbit, which should be raised if the orbital plate is to be removed. Separate the masseter muscle from the malar bone; divide the buccal fascia; depress the inferior maxilla, and pass a pointed elevator, or the finger if possible, into the posterior nares, carrying it by way of the lateral opening through the pterygo-maxillary fissure into the spheno-maxillary fossa, thence through the spheno-palatine foramen, all of which passages may have been distended by the morbid growth. A small keyhole saw is passed by the same route, and the superior maxilla divided from behind forward in the line of the lower skin incision (Fig. 338, F, F). The extremity of the saw is covered by the end of the index finger carried into the pharynx through the mouth, to protect the tissues from being injured by it. The zygomatic process of the temporal, frontal process of the malar, and orbital plate of the superior maxilla are then sawed through from behind forward to the lachrymal bone, the saw here being made to pass in its course through the spheno-maxillary fissure. Or the superior maxilla can be divided in the line of the superior incision of the soft parts, thus leaving the orbital plate intact. The osteo-cutaneous flap is now raised by an elevator carried beneath the malar bone and slowly lifted upward and inward toward the nose, the bones and soft parts of which form a hinge to the flap at that side. If the saw can not be passed into the posterior nasal cavity even by the aid of a grooved director, the lips of the incision of the soft parts may be drawn asunder, and the bone sawed from without inward and before backward.

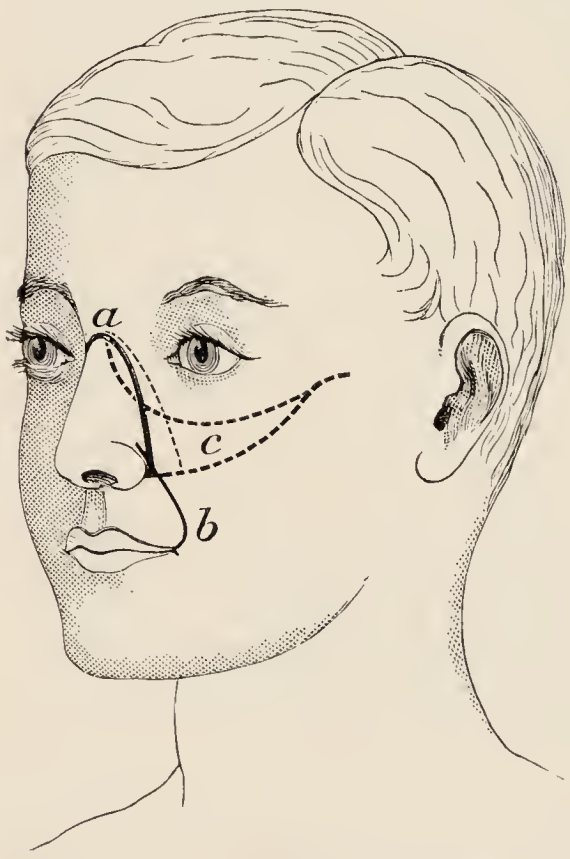



FIG. 758.—*a*. Ollier's incision. *b*. Guérin's incisions. *c*. Langenbeck's incision.

*The Comments.*—The operation is usually attended by quite severe hæmorrhage, which, however, can be controlled readily by pressure and an occasional ligature. After the removal of the growth, the parts are adjusted and confined in position by sutures, etc. If the growth to be removed be a large and vascular one, a preliminary tracheotomy should be done. If it be malignant or very vascular, and have a large attachment, we deem it a wise precaution to tie both external carotids prior to removal. The dangers from hæmorrhage will be lessened by this measure, and, moreover, the diminished vascularity of the parts will hinder the redevelopment of the growth. *Dawbarn* practices the removal of these vessels and for similar reasons.

The division of the bones can be readily and advantageously done with an osteotome and mallet (Fig. 394), especially when the spaces at the back of the jaw are not sufficiently distended by the growth to permit a wise use

of the saw. The difficulty of raising the flap and of returning and properly adjusting it, thereby incurring the dangers of necrosis, with consequent sepsis and non-union, are objectionable features of the measure.

*The Results.*—The rate of mortality from this method is less than twenty-five per cent, and depends more on the dangers arising from the removal of the growth than those the result of the steps necessary to reach it. The mortality is greater when the operation is done through the hard palate than when performed by means of the displacement of the upper jaw.

*Guérin's Method.*—Make an incision along the facial line from the ala of the nose to the angle of the mouth; dissect up the soft parts, opening the nostril, and bare the malar process of the superior maxilla; introduce a saw or chisel into the nose and divide entirely the maxilla horizontally backward below the infraorbital canal; separate, through the mouth, the soft from the hard palate with a scalpel; remove a middle incisor tooth and divide the hard palate in the median line with a saw or chisel. The fragment is then taken away with lion-jaw forceps.

*The Remarks.*—This operation is an excellent one so far as deformity is concerned, and can be practiced even without division of the lip. The employment of an artificial appliance to the roof of the mouth will remedy the resulting defect in speech (page 326).

*Kocher's Method.*—Place the patient in Rose's position and divide the upper lip from above downward; sever transversely down to the bone the reflection of the mucous membrane above the alveolar process; with a chisel cut through obliquely on a level with the nasal process the superior maxillary bones (Fig. 759); divide the alveolar process and the hard palate in the median line and draw the bones apart with hooks; incise the mucous membrane of the floor of the nasal fossa close to the septum, and push the vomer to the opposite side, thus exposing freely to observation the naso-pharyngeal space. After removal of the tumor, restore and fasten the parts in position with wire or an interdental splint.

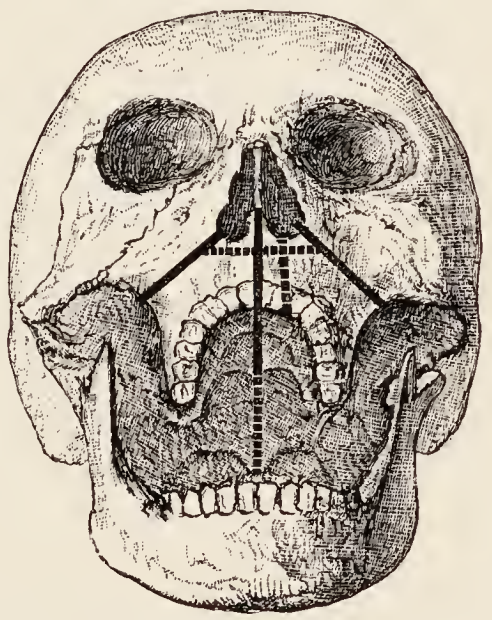


FIG. 759.—Kocher's method.

*Cheever's Method.*—In Cheever's case both superior maxillæ were removed, owing to the large size and central situation of the growth. Cheever made an incision from near the inner canthus on each side of the nose, downward along the natural furrow, around the alæ to the median line of the lip, which he divided. These flaps were reflected upward and outward as far as the malar prominences, and the body of each superior maxilla was sawed from behind forward to the middle meatus of the nose; the septum and vomer were cut with scissors; the jaws were then depressed and the tumor removed, after which the bones were replaced and wired in position. The loss of blood was not great, but the patient died on the fifth day from exhaustion.

*The General Comments.*—The excision of the entire upper jaw may be practiced for the removal of neoplasms, or only the portion below the line

of the orbital floor may be removed. The superior maxilla can be raised and turned outward on a hinge formed by the zygomatic process of the malar bone and the contiguous soft parts by dividing the bone in the line of Ferguson-Webber's incision (Fig. 333, *b*, *b'*), the upper portion of which, for this purpose, should be extended to the malar bone. The maxillæ are separated by sawing through the hard palate and alveolar process, and the nasal bone is disconnected from the superior maxilla by severing its connections with bone forceps. The osteocutaneous flap can then be raised and swung outward. If necessary, the soft palate may be divided. After the removal of the growth, the parts, including the soft palate, are adjusted and joined by sutures.

With the view of avoiding as far as possible the division of the terminal filaments of the superior dental nerve, and obviating the loss of function incident thereto, Langenbeck recommended that a curved incision be made, crossing the cheek about midway between the angle of the mouth and the lower border of the orbit, beginning near the lower end of the nasal bone and extending downward and outward and then upward, so as to avoid Steno's duct. The flaps are dissected from the superior maxilla, which is removed through the opening made in the soft parts. If the whole bone is to be excised, the integrity of the superior maxillary nerve can be still further preserved by removing it in advance from the infra-orbital groove by the aid of a fine, sharp chisel.

The removal of a growth of any great size from the posterior nares or pharynx, especially the latter, will be attended, if its attachment be extensive, by the entrance of a large amount of blood into the pharynx and trachea; it is therefore wise to do a preliminary tracheotomy, so that the lower extremity of the pharynx may be closed by sponges or otherwise tamponed. If the shoulders be elevated and the head allowed to fall far backward, the blood can be removed from the dependent portion of the pharynx as fast as it collects; this position, however, impedes respiration by overextending the muscles that act on the os hyoides. If a preliminary tracheotomy be done, the anæsthetic must be administered through the tube. The apparatus devised for this purpose by Trendelenburg (Fig. 1283) may be used entire, or only the inhaling portion attached to the ordinary tracheotomy tube can be employed; the latter plan is generally to be preferred, since the rubber tampon attached to this tube often causes bronchial irritation when inflated; moreover, if it become ruptured during the course of an operation, or be imperfectly distended, blood may enter the trachea unawares.

*Extemporized substitutes* for this purpose can be provided if a rubber tube of suitable size and length be attached by one extremity to the tracheotomy tube, and the other be inserted loosely into the bottom of an empty quarter-pound ether can and fastened there, and a sponge be introduced into the can and kept moistened with ether (Fig. 747, *f*). The anæsthesia thus produced will be eminently satisfactory and the outlay nominal. In the absence of the ether can, pass the end of the rubber tube through a tightly fitting opening in the center of a pasteboard diaphragm properly

adjusted to a glass tumbler in the bottom of which rests a sponge moistened with ether (Fig. 747, *e*).

*The choice of operation* is regulated largely indeed by the size, situation, attachments, vascularity, and nature of the growth. If the growth be comparatively small, with a well-defined pedicle, and accessible through the nose, this channel may be adopted. Annandale's, Boeckel's, and Guérin's methods are suited to the treatment of large naso-pharyngeal growths. Langenbeck's method is quite commonly practiced, and is an admirable one, especially when the naso-pharynx is much distended by the growth. The removal entirely or the swinging outward or inward of the superior maxilla, after free incision, affords a fine exposure of the naso-pharynx, especially the removal of the bone. In one instance the author practiced removal with great operative satisfaction, and followed with but slight cosmetic defect.

*The after-treatment* is essentially that for removal of the jaw (page 325).

*The Results.*—About twenty-five or thirty per cent die from the operation. Here, as in excision of the jaw for other reasons, septicæmia, etc., claim a share of the victims. According to Lincoln, twenty per cent die from the operation, and in about thirty-six per cent the disease returns within twelve months after the operation. We are disposed to regard the latter figures as having a decidedly optimistic expression.

**Deviation of the Septum Nasi.**—It not infrequently occurs that both the bony and cartilaginous portions of the septum are deflected to such an extent as to seriously interfere with breathing through the nose during attacks of coryza, and likewise to impart a distinct nasal twang to the voice. This deformity may or may not be associated with external modifications of the nasal symmetry. In either case the indications remain the same—to overcome the deformity and to maintain the corrected relations of the parts until recovery takes place.

*The Operation.*—The deformity can be overcome by grasping the abnormal septum between the blades of a forceps especially designed for the purpose (Fig. 761, *f*), which are thrust into the anterior nares and closed upon the deformed septum and held for a few moments with sufficient firmness to press its irregularities into a normal position. This resistance is still further overcome by cautiously turning the forceps from side to side on its long axis. The pressure exerts a crushing and compressing influence on the septum, permitting of its being pressed into a normal position. The retentive apparatus is a specially constructed clamp (Fig. 760), which is screwed into position while grasping the septum. This instrument retains the part thus rectified until the reparative processes necessary to permanency shall have taken place. The clamp may remain in position two or three days, not tightly screwed, for this would cause ulceration, but closely enough to exert a gradual controlling influence on the structure. This indication can likewise be well met by introducing into each nostril rubber tubes of proper size and length, sur-

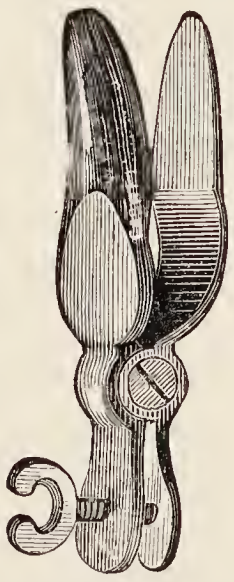


FIG. 760.
Adams's clamp.

rounded by oiled lint. After three or four days either of the preceding appliances should be replaced by splints (Fig. 761, *e*, *h*, *d*)), which are pushed into each nostril and worn at night only. This treatment is annoying and even attended by positive discomfort, but the good result will amply repay the patient for the infliction incurred. Other operations are recommended, such as the removal of the inferior turbinated bone on the side of the deflection; or punching the septum to establish a communication between the closed and the unclosed nostrils. Neither of these acts rectify the deformity, and both are open to objections, the former of a physiological, the latter of a mechanical nature. The removal of the projecting portion of the cartilage and its mucous membrane is likewise commended. The taking away of the deformed septum, together with a portion of the superior maxilla

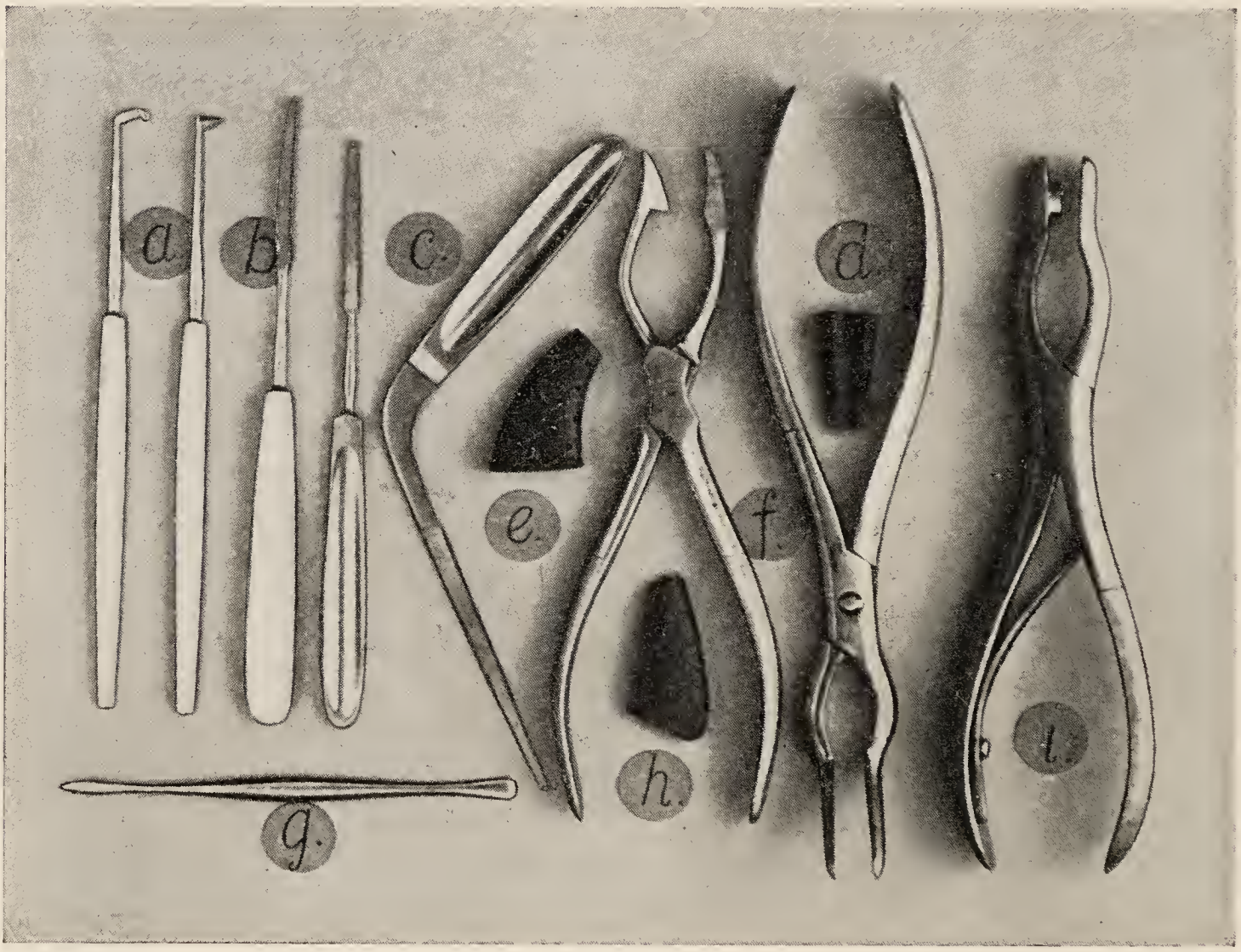



Fig. 761.—Instruments employed in treatment of deviation of the nasal septum.
*a*. Douglass's knives. *b*. Mial's and Curtis's saws. *c*. Bosworth's saw. *e*, *h*, *d*. Asch's, McKernon's, and Douglass's nasal splints. *f*. Asch's scissors and septum compressor. *i*. Douglass's perforator. *g*. Elevator.

(Post), accomplished by separating the side of the nose from the cheek, and turning the nose over, thus gaining access to the obstruction, constitutes an operation whose severity is out of proportion to that of the primary difficulty, and may be followed by an unsightly scar. It is recommended also that the meatus be burred out (Wagner) by means of the dental engine. The reported results certainly give strong testimony in favor of this proposition. The deformed portion of the septum may be sawed off on a plane conforming to that of the remaining portion by first applying a strong solution of cocaine to it, then removing the deformity

with a narrow, fine saw (Fig. 761, *c*) constructed especially for the purpose. This plan is practiced by Bosworth, and it appears to be preferable to burring or punching the septum.

## THE OPERATIONS ON THE ŒSOPHAGUS.

The nature of the functions and the important intimate anatomical environments of the œsophagus contribute greatly, indeed, to the difficulty of treatment of this passage, and also favor the development in it of obstructive changes of grave import. The anatomical relations of this tube should be carefully considered, and the possibilities of a cure cautiously weighed, before active interference is begun. Otherwise, what appears to be a simple matter and quickly curable may by illogical effort become suddenly of the greatest import and of irremediable nature.

*The Anatomical Points.*—The œsophagus begins at the cricoid cartilage on a level with the sixth cervical vertebra. It lies in the median line at the beginning, but bears off half an inch toward the left in the cervical region; then returns to the median line at the fifth dorsal vertebra and again tends slightly toward the left as it passes through the diaphragm, terminating opposite the ninth dorsal spine behind, which corresponds to the left seventh chondro-sternal junction in front. In a sagittal direction the œsophagus corresponds to the curves of the portions of the spinal column with which it is associated. The average diameter is about four fifths of an inch; the smallest—a little more than half an inch—is wisely placed at the beginning of the tube; the second narrowing is opposite the fourth dorsal vertebræ, the third at the diaphragm. The narrowest parts can be dilated to three fourths of an inch and the remainder to an inch and a half in the dead subject. The transverse diameter exceeds the antero-posterior. Since these measurements are based on post-mortem experiments, they can be regarded only as indicating rather than establishing the limits of dilatation, a fact which is emphasized frequently in the living by the ready passage along the œsophagus into the stomach of articles of much greater dimensions than are those assigned to the passage itself. When empty the œsophagus appears as a flat muscular tube. *Ogstan* considers that food traverses the normal œsophagus in about four seconds. *Cannon* and *Moser* determined that fluids "are propelled deep into the œsophagus" at the rate of seven feet per second.

The consultation of a text-book on anatomy will promptly suggest those important relations which, in the presence of disease or invasion, invite disaster if unwisely disturbed. The trachea, carotid vessels, aorta, pericardium, left bronchus and mediastinum, are of special importance in this regard.

**Foreign Bodies in the Œsophagus.**—The nature, shape, and size of the foreign body, together with the situation and time of impaction and the symptoms, must be ascertained with deliberation if the condition of the patient will permit. Foreign bodies are arrested commonly at the narrowest parts of the œsophagus, therefore, usually at the beginning. At this situation the foreign body can be easily touched with a probang and often with the index finger, although not without causing the patient distress if con-

sciousness be present. Careful examination of the left side of the neck, behind the cricoid cartilage, will often disclose the presence of the obstruction. When situated lower down, the probang and bougie will establish the fact (Fig. 762). After failure of the simpler means of removal—i. e., external manipu-

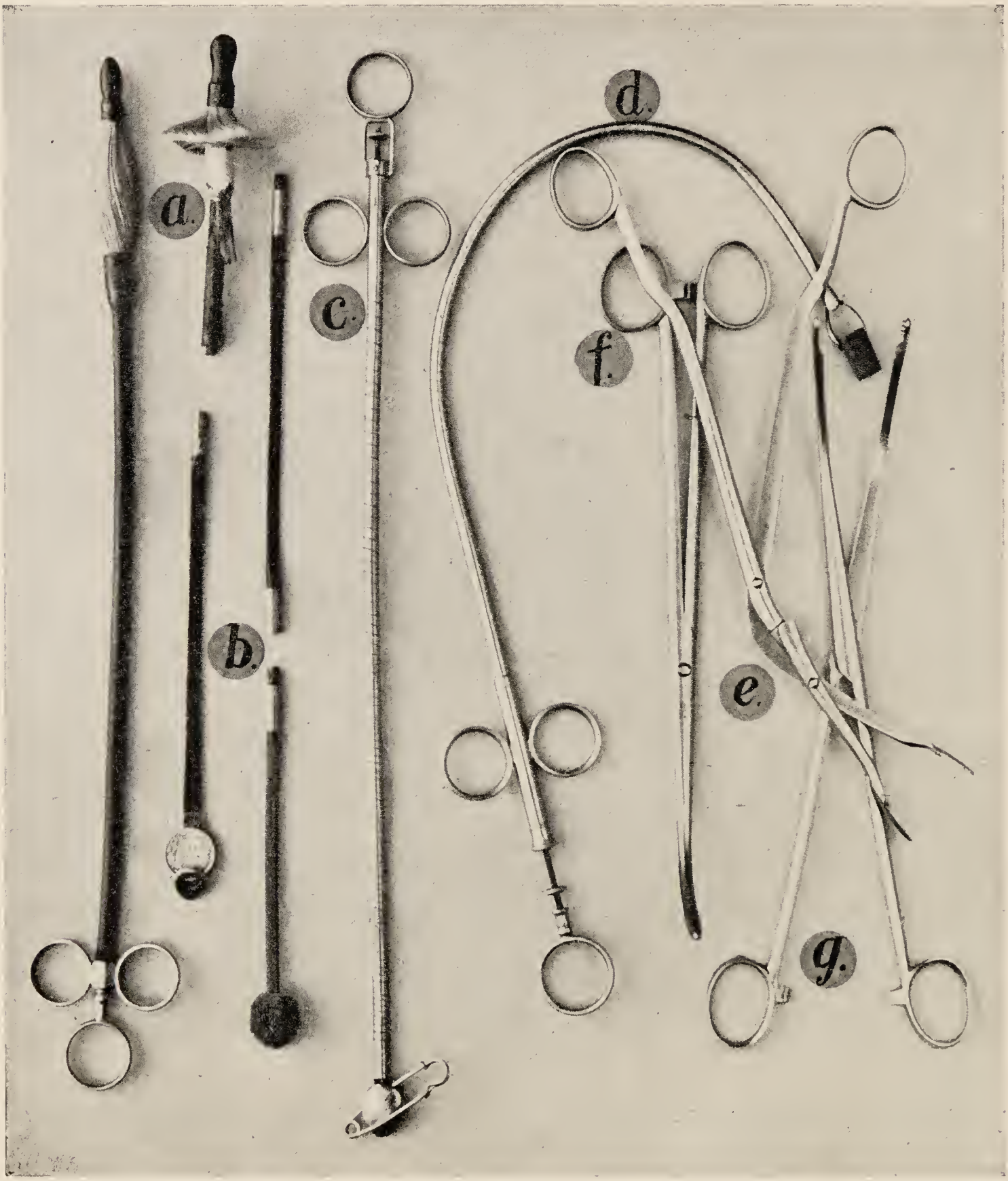



Fig. 762.—Instruments employed in removal of foreign bodies from œsophagus.
*a.* Bristle probang, opened and closed. *b.* Coin catcher and sponge probang, whalebone. *c.* Roe's flexible coin catcher. *d.* Tiemann's flexible cork-catching forceps. *e.* Cusco's throat forceps. *f* and *g.* Curved throat forceps. Curved forceps of different patterns may be employed.

lation, emesis, etc.—the obstruction is usually removed at the higher situation with throat forceps designed for the purpose (Fig. 762, *e*), or by the bucket probang (*b*), or by a loop of wire, or other simple devices of this character. However, if the obstruction have been lodged here for some time, conse-

quent swelling of the soft parts, or irregularities of the foreign body, may render removal by way of the mouth impossible. The same may be said also of foreign bodies located elsewhere in the tube. The bristle and the sponge probang (Fig. 762, *a*, *b*) are the common implements for removal under these circumstances.

*The Remarks.*—It is seldom indeed that a foreign body causes complete occlusion of the œsophagus. Those too large to enter it encroach not infrequently on the larynx and cause death from suffocation. The lodgment of an article near the cardia is specially dangerous because of the proximity of the heart, great vessels, and pleura. While all bodies, irrespective of their physical characteristics, lodge most frequently at the established narrowings of the œsophagus, irregular and sharp ones may lodge between these points, but round and flat ones do not. External manipulation for removal is applicable only to the obstructions located in the cervical portion, and should not be practiced in the event of firm impaction or when marked asperities characterize the obstructing agent.

**The Introduction into the Œsophagus of Instruments.**—The introduction of an instrument into the œsophagus is usually a simple procedure.

*A Method of Introduction of a Stomach Tube.*—Place the patient in a good light while in a chair or sitting up in bed; tip the head backward and give it in charge of an assistant; gag the mouth; seize the tongue (guarded from slipping with a dry cloth) with the thumb and fingers and draw it forward, thus advancing the larynx; grasp the previously warmed and oil-smeared instrument lightly in the right hand; carry the end downward and backward to the posterior wall of the pharynx; push it along as the patient gags, and cause him to swallow as the advancing extremity engages in the lower part of the pharynx; advance the instrument with gentleness, heeding the presence of spasm or other obstruction, until finally the instrument passes readily along the œsophagus into the stomach.

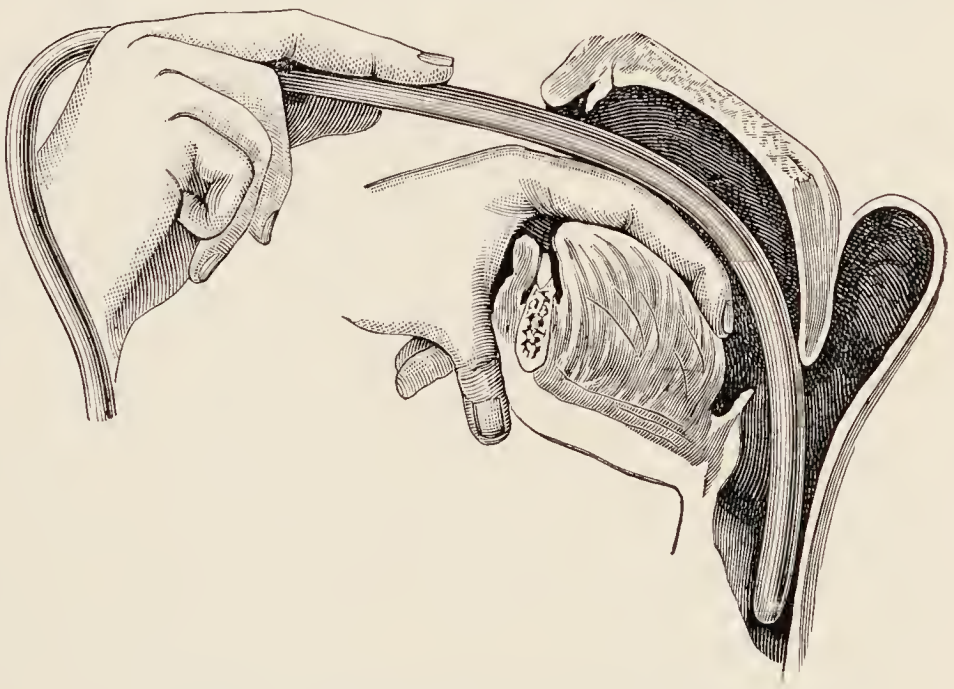


Fig. 763.—Introducing tube into œsophagus.

*Other Methods of Introduction.*—Instead of grasping the tongue the index finger can be introduced as a guide to the advancing instrument, as is commonly practiced in the introduction of an œsophageal bougie, conducting it safely over the larynx to the posterior aspect of the pharynx (Fig. 763). *Solis-Cohen* recommends the drawing of the larynx forward with the thumb and fingers applied without. The accomplishment by this method requires the employment of a firm and somewhat painful pressure (except perhaps in the presence of anæsthesia) that is out of proportion to the demands of the

case. The location of the obstruction can be estimated by recalling the fact that in the average-sized adult the distance from the diaphragmatic narrowing of the œsophagus to the upper incisor teeth is about fourteen inches and a half, and from the aorta and from the upper end of the œsophagus to the same teeth is nine and five and a half inches respectively. These facts are of immense importance as bearing on the relation of the obstructing agent to important organs and the liability of serious complications from the passage and from the effects of the means employed for relief.

*The Precautions.*—The introduction into and passage along the œsophagus of a probang, bougie, etc., and the manipulation of the foreign body should be conducted with great care and a minimum expenditure of force, otherwise perforation will ensue, and especially is this true in those cases characterized by the structural changes incident to disease and ulceration of the walls of the tube. Avoid entering the larynx with the instrument. Coughing and continued spasm of the larynx with the advance of the instrument indicate laryngeal invasion. The escape of air through a hollow instrument under these circumstances is diagnostic of entry to the larynx. Observe that the end of the advancing instrument be not curved forward, but instead that it lies in contact with the posterior wall of the pharynx. A cautious advance in the presence of spasm or other source of obstruction must always be observed. Relaxed and pouched states of the pharyngeal wall, notably at its junction with the œsophagus, oppose the progress of the bougie not infrequenlty, especially when the head is not well extended. Deflections and pouches of the œsophagus may interfere with the descent of the bougie, and this interference should not be opposed with vigor, for fear of causing perforation of the tube. The partial withdrawal of the instrument and the changing of its course should be practiced promptly in this instance. While cautious attempts made to dislodge an impacted body are always admissible, still in the instance of sharp and irregular impacted agents the manipulations should be much more guarded in time and method than when such bodies are regular and smooth. It is much safer to resort at once to the operative methods for extraction of the obstacle than to prolong and aggravate the case by renewed efforts of removal or by permitting the impacted body to remain, especially when it is contiguous to important structures. Sometimes the instrument becomes immovably engaged to a fixed obstruction, requiring operative procedure for the liberation and extraction of both, and the situation will decide whether gastrotomy or œsophagotomy shall be performed.

*The Remarks.*—The preparation of the walls of the pharynx for invasion with instruments, by a weak solution of cocaine, by titillation, the use of cold, etc., to arrest the spasm, can be practiced with discretion. If the presence of a foreign body be not noted with the downward passage of the bougie, the latter should be withdrawn to the upper end of the tube and the attempt repeated, unless disclosure attends the withdrawal. It should not be forgotten that the presence of the foreign body may escape detection, and that it may cause death from perforation of the large vessels, heart, or pleura, without the occurrence of any significant premonitory symptoms.

In children it is wise to employ an anæsthetic, as better control of them is thus maintained; in adults some assistance may be rendered by the sufferer, if not anæsthetized. Generally speaking, bristle probangs and coin catchers are used for the extraction of smaller, less fixed, and more distant bodies than those treated with the forceps.

*Many ingenious plans* of action *for the removal* of *special obstructions* have been devised and operated with success. Those for the removal of fish hooks and of pronged bodies swallowed with string attachments will suffice as examples of successful attempt, and are fertile with suggestion for future action. The line attached to the hook is passed through either a bullet or some other solid substance, or through a long, hollow bougie. In the former instance the weight of the bullet and the force of the effort at swallow-

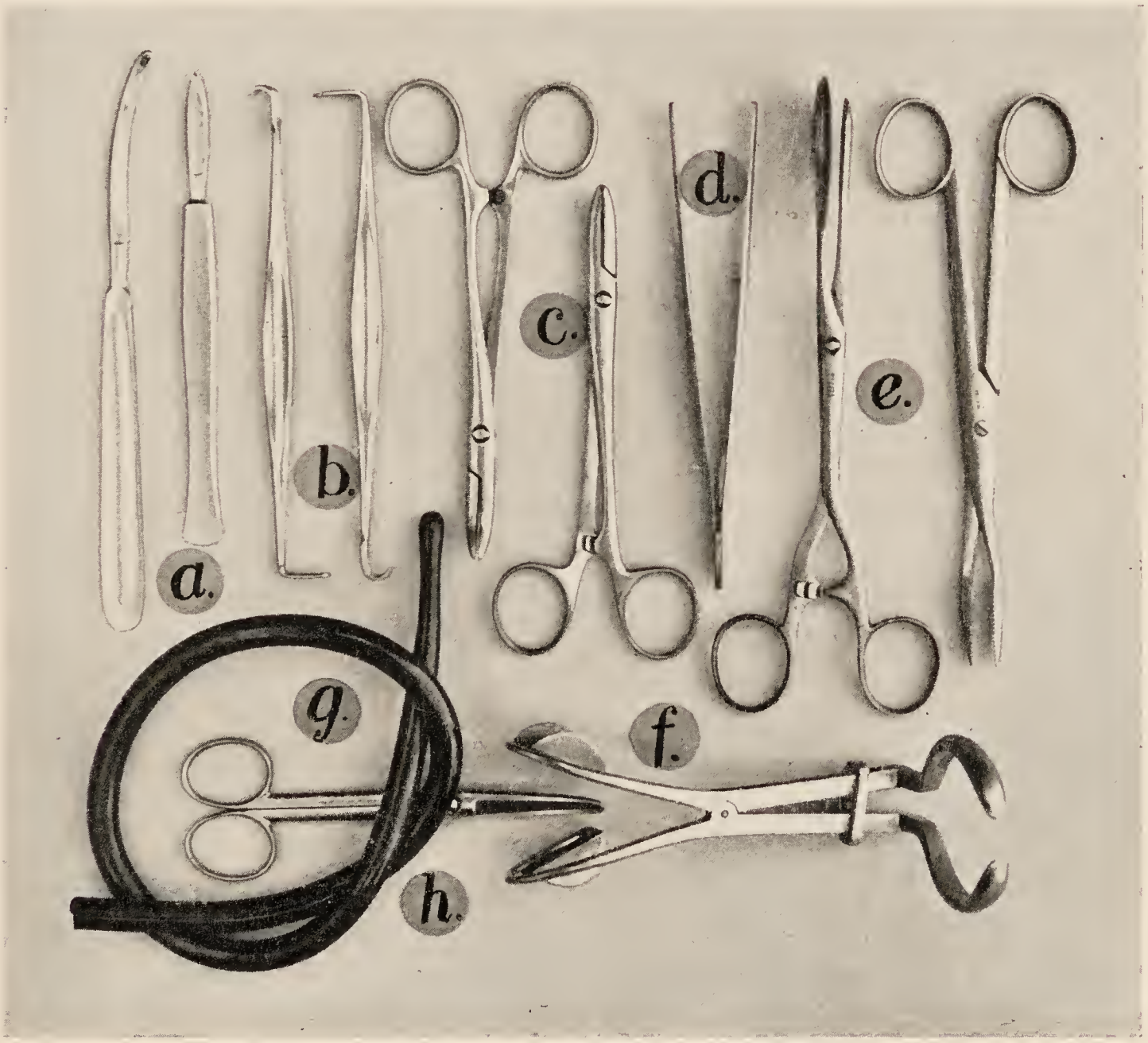



FIG. 764.—Instruments employed in œsophagotomy.

*a*. Scalpels. *b*. Retractors. *c*. Forcipressure. *d*. Mouse-tooth forceps. *e*. Tongue forceps and forceps for extraction of foreign body. *f*. Goodwillie's mouth gag. *g*. Curved scissors. *h*. Œsophageal bougie. Drainage tube, wipers, ligatures, traction loops, etc., are essential.

ing dislodge the hook; in the latter, when the lower end of the bougie reaches the hook, it disengages it by direct downward pressure (Mackenzie).

The swallowing of a sticky bolus containing strong thread with a string attached, and the entangling of the foreign body thereby and its withdrawal

along with the thread, often affords a happy solution of the difficulty (Créquy).

If a foreign body be immovably lodged in the œsophagus it must soon be taken away through an external incision, or a fatal result will ensue, due to ulceration or extravasation, or perhaps to starvation alone.

*The œsophagus can be entered* for this purpose from without *through the neck*, *the thorax*, *or the stomach*, depending on the situation of the obstruction.

**Œsophagotomy.**—The operation of œsophagotomy is practiced for the removal of obstructions in the cervical and upper dorsal portions of the œsophagus, commonly caused by the lodgment of foreign bodies.

The situation of the foreign body in the cervical region is usually determined by the presence of a prominence at the left side below the cricoid cartilage; or, if this be not manifest, the exact site of lodgment in the canal can be determined by the introduction into it through the pharynx, of a good-sized bulbous or other form of bougie (Fig. 764, *h*).

The *important surgical relations of the œsophagus* in the cervical region are: *In front*, with the trachea above and with the thoracic duct and the thyroid gland below; *behind*, with the vertebral column and longus-colli muscles; *at the sides*, especially the left, with the common carotid and inferior thyroid arteries and thyroid lobes. The recurrent laryngeal nerves lie between the œsophagus and the trachea on the respective sides.

*The Operation of Cervical Œsophagotomy.*—After thorough aseptic measures employ an anæsthetic; place the patient on the back, with the chest and shoulders elevated and the head turned to the opposite side; feel for the foreign body, and, if it can be located, make the incision directly at that point.

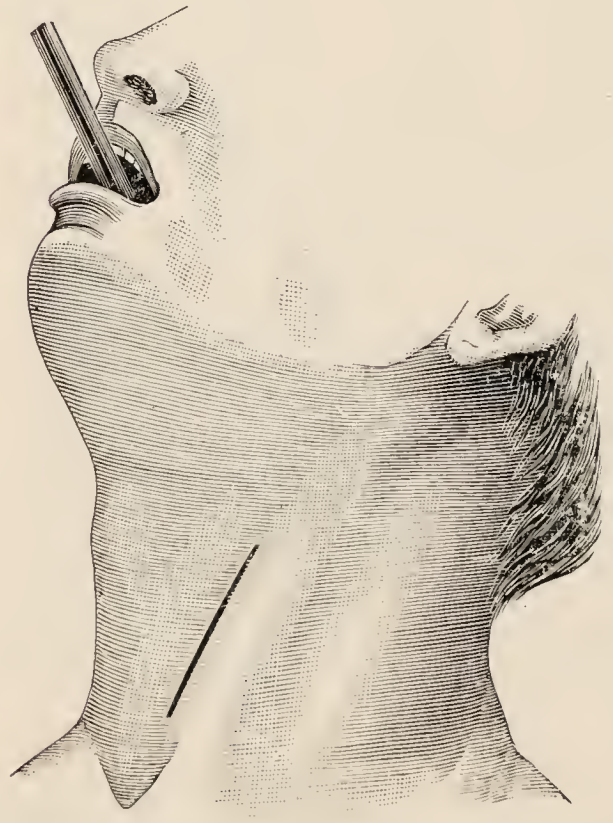


Fig. 765.—Œsophagotomy, primary incision.

If the foreign body be not discernible by touch, make an incision about four inches in length on the left side, between the sterno-mastoid muscle and the trachea, beginning at the upper border of the thyroid cartilage (Fig. 765). The platysma and fascia are divided on a director; the borders of the wound are separated, the omo-hyoid is drawn outward, and the sterno- and thyro-hyoid muscles inward; this exposes the sheath of the carotid, which vessel is drawn outward and retained; the lobe of the thyroid gland is raised and drawn inward; the larynx is carefully outlined, drawn forward, and held while the location of the foreign body is sought for; if the latter be not distinguishable a bougie is introduced to mark the outline of the tube; then raise the wall with mouse-tooth forceps or a tenaculum, and open it longitudinally (Fig. 766) sufficiently to admit a good-sized probe, care being

taken to avoid the recurrent laryngeal nerve. The site of the obstruction is located by the probe and the obstruction is removed with suitable forceps, aided by manipulation from without, and facilitated by lengthening the œsophageal incision if necessary. The opening in the œsophagus may be closed with two rows of fine catgut sutures, the inner being applied to the mucous membrane only, if the borders of the incision have not been injured by manipulation or impaired by the lodgment of the foreign body; if, however, either of these conditions be present, closure should not be attempted. In no instance is it wise to close entirely the external incision, although it may be narrowed by suturing the upper portion. Antiseptic gauze is packed lightly in and over the wound, and confined in place loosely with a gauze bandage. The aim must be to keep the wound clean and prevent extravasation through and inflammation of the cervical tissues.

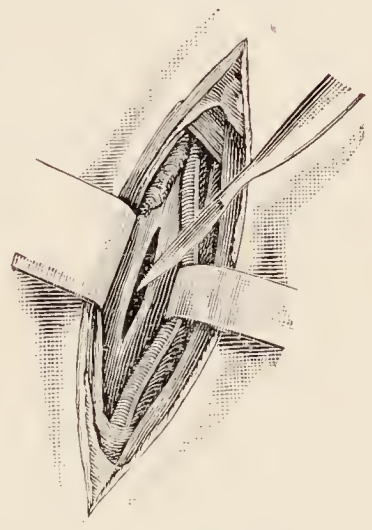


FIG. 766.—Œsophagotomy, final incision.

*The Fallacies.*—The foreign body may be mistaken for an enlarged gland on external examination. The œsophagus may be confounded with the longus-colli muscle at first; however, a moment's examination will serve to dispel the doubt. The respiratory movements of the œsophagus, distending and collapsing alternately, are important aids in determining its identity. It must not be forgotten that the swelling, pain, and tenderness elicited by external examination of the neck are not necessarily at the exact site of the agent causing them, and, too, that exploratory agents do not always indicate the presence of a foreign body. The efforts at upward removal of a foreign body that has as yet caused no significant damage in its downward course are often repulsed by œsophageal peristalsis to a degree that renders removal upward unwise and perhaps impossible, especially if the object be bulky and of irregular outline.

*The Remarks.*—If the foreign body be not located near the opening in the œsophagus, the canal should be explored upward and downward for its detection. If below, it may be at the narrow part of the œsophagus located opposite the fourth dorsal vertebra, from which point it may be removed with the use of properly constructed forceps. During the operation all bleeding points should be controlled promptly. The situation of the inferior thyroid artery, the anterior jugular vein, and the recurrent laryngeal nerve should be clearly understood, and needless injury of them avoided. With this object in view and to avoid the nerve, the incision into the œsophagus should be made as far posteriorly as practicable. The opening in the œsophagus may be dilated by the introduction of the blades of curved dressing forceps or the lips pulled apart by traction loops introduced through the borders of the œsophageal wound. If the obstructing agent be accessible and fixed in place by its irregularities and projections, these, or the object itself, can be divided with bone forceps and afterward easy removal accomplished. *Richardson* has determined that the index finger, when introduced into the œsophagus through a low cervical incision

(low cervical œsophagotomy), can reach the arch of the aorta and in some instances pass beneath it, also readily appose an index finger introduced from below through the stomach. The utilization of this method of manipulation serves an important purpose in the dislodgment of impacted bodies and in the dilatation of strictures. Not infrequently prompt union of the borders of the wound has resulted in immediate healing; but this course of action is not to be regarded as wise except in special instances, and then under close surveillance. The insertion into the bottom of the wound of a small drainage tube is desirable in cases in which too free separation of the tissue has occurred, and where free discharges are anticipated. If the tissues at the seat of the obstruction are already inflamed, emphysematous, etc., œsophagotomy should be practiced at once and the wound left open, thoroughly drained from the bottom, and lightly dressed with antiseptic materials. When the nutrient enemata are not retained or are insufficient for proper nutrition, a feeding tube should be introduced through the mouth or nose into the stomach, and be kept in place or passed at intervals for a time, as circumstances may demand. When illy borne at these situations, the introduction through the wound is advisable. Ordinarily the operation of cervical œsophagotomy is not a perplexing procedure; but when the neck is short or fat, the vessels and thyroid gland enlarged, the detection and removal of the foreign body difficult, or the patient is exhausted, the operation often taxes the patience and fortitude of the surgeon.

*The After-treatment.*—Keep the patient in bed with the head and shoulders raised, and the head so confined that the movements will not disturb the relations of the tissues of the wound. For the first day or so nourish the patient by the bowel, after this by means of the stomach tube, until the œsophageal wound is healed. In the case of a six-year-old patient operated on by the author, fluid food was given by the mouth after forty-eight hours, and the escape from the wound, during the act of swallowing, was reduced to a minimum by gentle pressure upon it, made with a good-sized pledget of aseptic cotton batting.

*The Results.*—Eighty-two cases are reported, of which nineteen died, but from causes independent of the operation in many instances. The rate can be placed at about twenty-two per cent, which will surely be lessened in the future, if the operation be done as early as it should be. Promptness of operative action lessens the rate of mortality, as a death-rate of 19.5 per cent follows operations made during the first three days, and 32.1 per cent after that time.

*Silver* reports one hundred and sixty-five instances of cervical œsophagotomy for the removal of foreign bodies since 1870, in which one hundred and twenty-seven recovered and twenty-eight died.

*Foreign bodies in the intrathoracic portion of the œsophagus* can be located with ease by a probang. If situated at the upper portion, the removal may be accomplished through a low cervical œsophagotomy and with the use of long curved forceps. Inasmuch as the œsophagus is quite narrow opposite the body of the fourth dorsal vertebra, it is fair to assume that the lodgment will be at this point. However, if below this place, the difficulty

of removal through a cervical incision will be greatly increased, if not made impossible. But, inasmuch as comparatively safe relief through thoracotomy is as yet quite improbable, prompt, cautious, and intelligent efforts should be first employed at upward removal, not sufficiently prolonged, however, to impair the chances of more rigorous methods. Failing in these attempts, removal may yet be attained through the *performance of thoracotomy* or *gastrotomy*. The former method of relief is fully described on page 1029 *et seq.*

**Gastrotomy.**—*The employment of gastrotomy* for the relief of œsophageal obstruction from any cause is ingenious and usually effective. (See Instruments Employed, page 740.)

*The Operation.*—An incision is made in the median line between the umbilicus and ensiform cartilage two or three inches in length, the anterior surface of the stomach is drawn forward and opened, the left index finger or the hand is introduced, and the cardiac orifice sought for, by directing the index finger upward, backward, and to the left opposite to a point just outside of the articulation of the costal cartilage of the seventh rib with the sternum. From this time forward either one of two plans of removal can be practiced: 1. The drawing upward into the mouth of the foreign body by means of a sponge (Bull) or other suitable entangling agent connected to a string introduced at the cardiac orifice through the opened stomach, and carried upward beside the obstacle and out of the mouth by means of a small bougie. 2. By dilatation of the cardiac orifice and the lower part of the œsophagus with the index finger (Richardson) or a suitable instrumental dilator, and the removal of the foreign body downward by forceps, or by the employment of the sponge and string introduced in the reverse manner to that already described. Richardson advises that foreign bodies located thirteen inches or more from the incisor teeth be removed by the latter plan.

*The Precautions.*—The removal of foreign bodies from the œsophagus through the stomach should be conducted with great care and infinite patience by means of forceps, supplemented with dilatation of the opening, and downward pressure by way of the mouth, combined with dextrous handling of the obstructing body. Rapid, forcible, and illogical attempts at withdrawal cause lacerations and perforations of the œsophagus, followed by the unfortunate sequelæ which such procedures invite.

*The Comments.*—The size of the abdominal and of the gastric incision is regulated by the necessity of the case, which necessity should be promptly recognized in order to facilitate the operation and lessen the danger. Before the incision is made into the stomach careful packing around the organ at the borders of the abdominal wound should be practiced to obviate peritoneal infection. Forcible manipulations in the extraction of foreign bodies, or in extended digital exploration of the stomach or the œsophagus carried on through inadequate incisions, are often needlessly prolonged and are harmful. When the size and mobility of the stomach will permit it should be extensively drawn through the abdominal opening before being incised or explored (Fig. 767). Transverse openings into the stomach cause less hæmorrhage than longitudinal ones; but extensive longitudinal incisions made midway between the greater and lesser curvatures do not, for anatomical

reasons, cause dangerous hæmorrhage. In digital and instrumental explorations the gastric incisions are made comparatively small and located so as to shorten the route to the objective point. In digital exploration of the stomach it is difficult indeed sometimes to locate with the fingers the site of

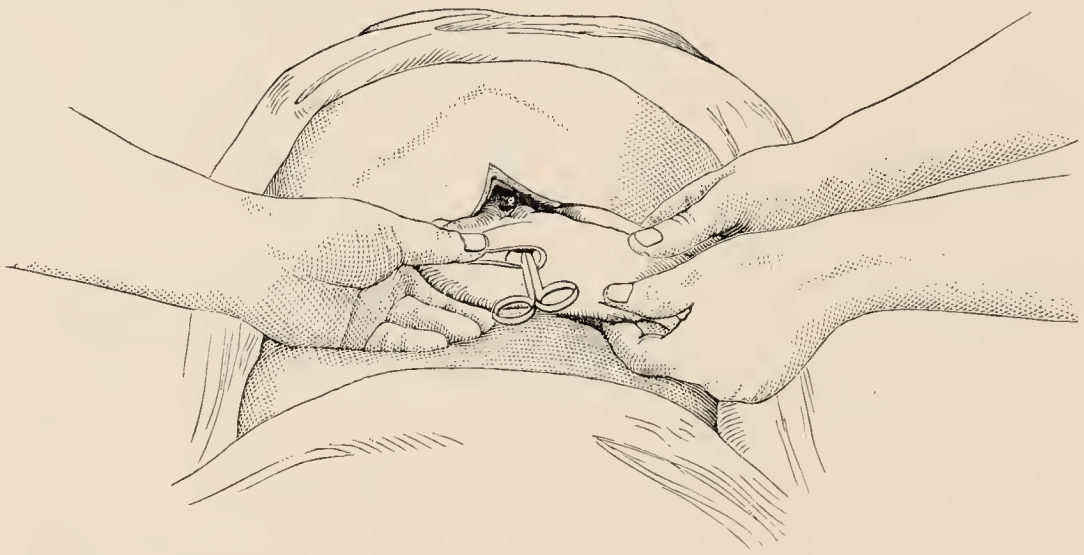


Fig. 767.—Delivery of stomach and introduction of forceps.

the œsophageal opening, because of its obliteration due to contraction of the walls of the stomach, provoked no doubt by the presence of the finger. However, if the finger be pressed cautiously for a time at the site of the opening relaxation will take place and the end of the finger will readily enter the tube. Downward traction on the stomach attended with flexion of the cervical and dorsal portions of the spine render the cardiac opening more accessible to manipulation. The putting of the lesser curvature on the stretch by downward traction on the stomach enables one to readily pass a bougie along the curvature into the cardiac opening, especially if the gastric incision be located well to the right.

**Stricture of the Œsophagus.**—For the purpose of consideration, stricture of the œsophagus will be classified as malignant and non-malignant, and although either may be treated by *dilatation*, *divulsion*, *external* or *internal division*, or *tubage*, it will appear that a diversity of modes of treatment is better. In the œsophagus as in the urethra, the first indication consists in locating the seat of the stricture, after which the treatment suited best for the case is carried into effect. Sometimes supplemental steps, such as opening the stomach or œsophagus, are needed to bring the stricture within the proper reach of the curative manipulations. Bulbous bougies (Fig. 767) are the common diagnostic agents employed. The fluoroscope, when used in connection with a metallic bougie or with any shadow-casting substance introduced into the œsophagus, affords an excellent means of locating a stricture and of computing its relations to contiguous bone structures.

*Dilatation* is the simplest and safest method of practice in non-malignant stricture. Direct and retrograde dilatation are the methods employed. The variously formed and sized bougies are utilized for the purpose, and the finest filiform variety may fail to pass. The size should be increased from time to time, and when directly used, the instrument should be introduced in the manner already described (page 593).

The introduction is practiced once in two or three days, according to the characteristics of the constriction. The possibility of the presence of aneurismal constriction of the tube should be eliminated before an attempt is made to overcome the obstruction.

*Retrograde Dilatation.*—Retrograde dilatation is directed to the treatment of stricture of the lower portion of the œsophagus by way of an opening through the stomach (gastrotomy), made as for the removal of foreign

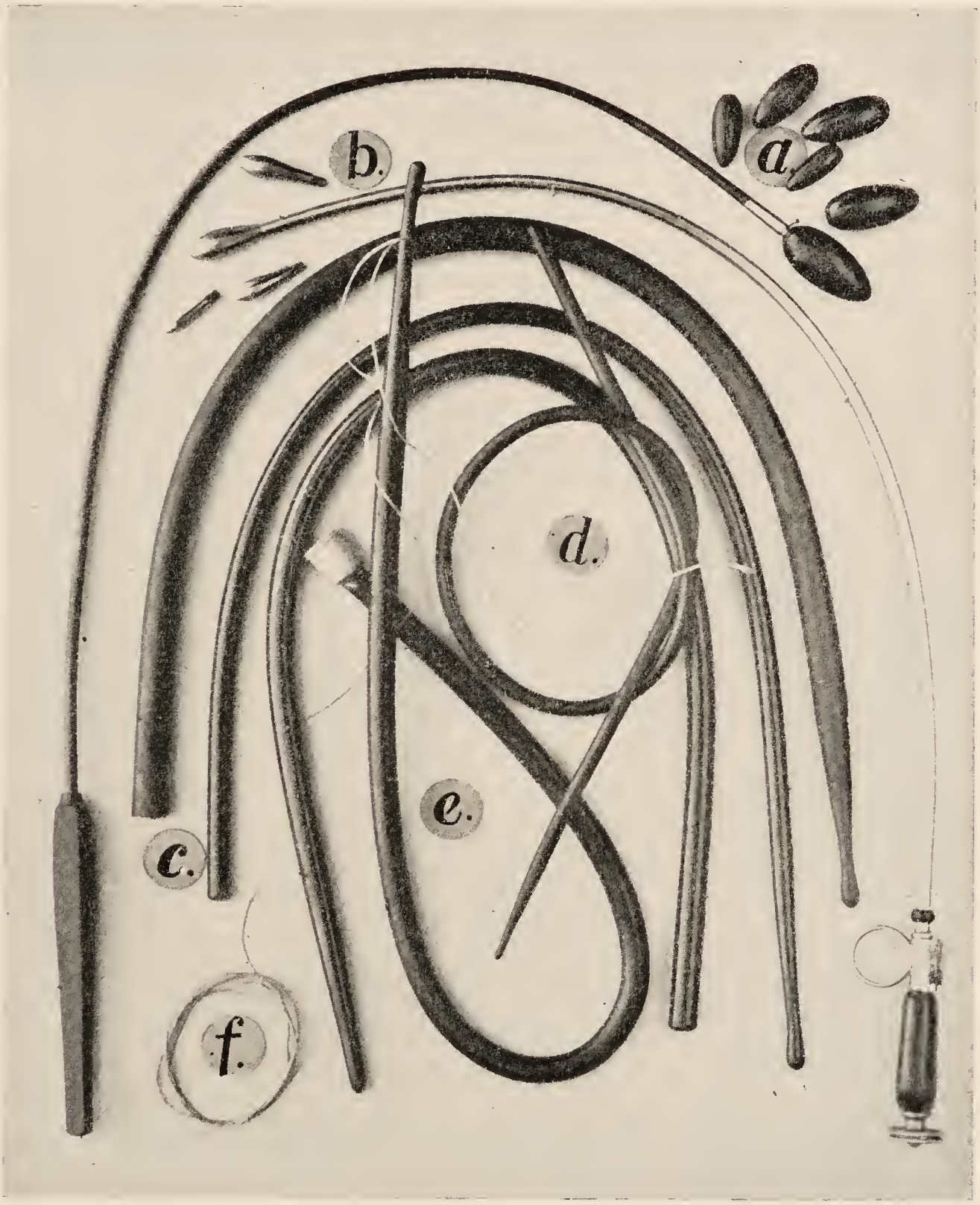



FIG. 768.—Instruments employed in treatment of stricture of the œsophagus. *a*. Whalebone bougie, bulbs of assorted sizes. *b*. Sands's œsophagotome, bulbs of assorted sizes. *c*, *d*. Bulbous and pointed bougies. *e*. Bougie with string attachment. *f*. String for friction purposes. Bougies of various materials and of assorted sizes are for sale.

bodies, or through the fistula of gastrostomy, as the nature of the case shall determine. And in neither instance should the opening into the stomach be so small or so placed as to interfere with ready approach to the cardiac

orifice. Dilatation may be produced by the finger or by any of the stereotyped urethral or uterine dilators of suitable size and shape; also sponge tents, laminaria, and conical metal-capped bougies with string attachment are utilized for the purpose. Various devices for the primary introduction of a dilating agent are employed. The swallowing of a shot attached to a string (Socin) in advance of opening the stomach, and the pulling of the shotted end through the gastric opening to secure the return of a bougie or friction string, is an ingenious and effective measure.

By this means, too, Knott's conical bougies, and laminaria of increasing sizes, may be drawn upward, thus dilating the stricture. It is sometimes difficult to locate the cardiac aperture after opening the stomach, because of the obliteration of the orifice. The localization of it with the finger or with a bougie, as already described (page 600), may be practiced. The introduction of an endoscope along a string passed down from above (Silver), or of a tunneled catheter may suffice. Direct observation through the endoscope at the seat of the opening may detect the entrance to the stomach from above of fluid swallowed for the purpose (Lange). Other ingenious devices can be named, but sufficient is noted already to invite the exercise of discreet and fertile judgment in this regard.

*Divulsion.*—Divulsion of an obstruction is not as safe a procedure as dilatation. However, in the case of failure of the latter, divulsion can be carefully practiced when necessary, in the absence of other means of treatment. *Direct* and *retrograde divulsion* are employed. The former consists in the introduction through the stricture in prompt succession of two or more œsophageal bougies of graded size, with sufficient vigor to rupture in a minor degree the contracted tissues of the obstruction. The latter is practiced in a rapid and forcible manner through an opening into the stomach by the agents employed in dilatation.

The immediate results are quite satisfactory, and the patency of the tube may be maintained thereafter by the continued introduction of bougies by the direct method. *External division* or external œsophagotomy has been considered already (page 596). Strictures of the cervical portion of the œsophagus may be divided from without. The stricture is first located by a bougie introduced into the tube, and is then cut down upon through an external incision as in œsophagotomy.

*Internal Œsophagotomy* (Internal division).—Internal œsophagotomy consists in the division of the constricting tissue after the manner of urethral practice, with enlarged patterns of the instruments employed in internal urethrotomy (Fig. 768, *b*). An instrument arranged so as to be passed upon a guide, as in internal urethrotomy, has been successfully employed on several occasions in internal œsophagotomy. However, the contiguity of important anatomical structures, and the inability to comprehend the exact relations of the stricture to the outer wall of the tube, make the operation an exceedingly hazardous one. If it be attempted, the constriction should be incised only sufficiently to admit a bougie, by means of which dilatation should be subsequently practiced.

*The Results.*—In nineteen cases of internal œsophagotomy treated by incision, one third died in sixteen days from results associated with the



Fig. 769.—Abbe's string friction method; string escaping through a low cervical œsophagotomy instead of through the mouth.

operation. Of the remainder, three are said to have recovered, while the others survived for a period from one month to several years. About one third of the cases required one or more repetitions of the operation.

*The division* of the stricture *by* means of *string friction*, as devised by Abbe and practiced by himself and others, is a decided advance along the line of safety in the treatment of stricture of the œsophagus. The stomach is opened sufficiently to admit two fingers, along which as a guide, a bougie carrying a long silk thread is passed up the œsophagus and out of the mouth (Fig. 769). The lower end of the string is seized and the stricture made tense by the introduction of a conical bougie (Fig. 770); after which the upper end of the string is grasped and carried well back into the pharynx, while the lower end is carried into the stomach; then the string is drawn tight and moved rapidly upward and downward several times until the constricting bougie is released. This bougie is removed and the tension at the site of constriction renewed by the introduction of a larger one, and so on until the œsophageal tube is permeable or firm resistance is encountered by the string. As soon as a suitable sized bougie can be passed by the mouth, the operation is discontinued, the string is removed, the abdominal openings are closed, and thereafter bougies are introduced at regular intervals until all fear of closure ceases. It is not frequent that the conditions require the œsophageal incision, only, in fact, when the manipulations through other channels are futile, insufficient,

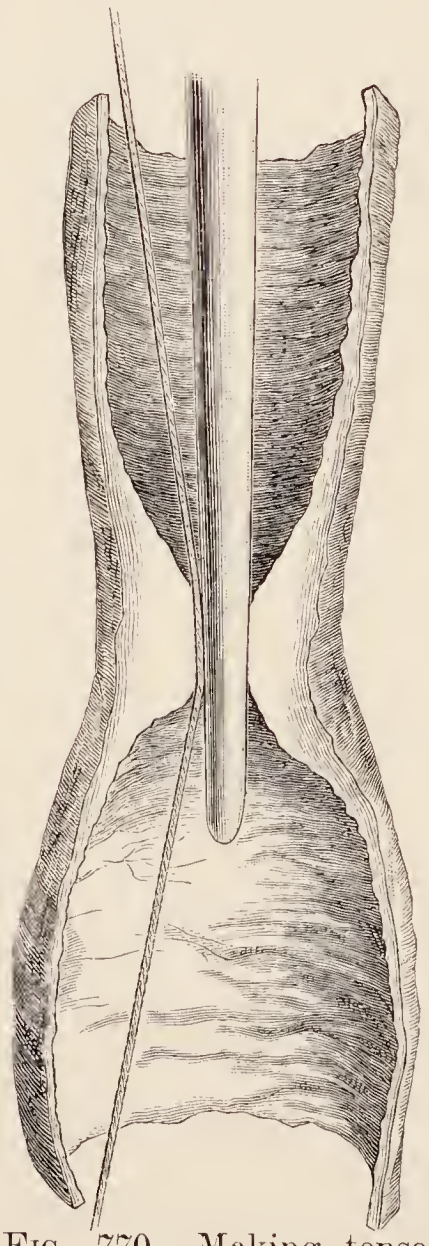


Fig. 770.—Making tense the stricture.

or needlessly dangerous to the patient. The author suggested not long since the employment of string friction through the mouth alone in the following manner: Introduce a long, firm, silken thread through an opening made transversely at the advancing end of a bougie (Fig. 768, *e*). Introduce the bougie through the mouth into the grasp of the stricture (Fig. 771), then seizing the ends of the thread make the rapid sawing motion while pressing downward upon the bougie, the thread being thus made to move to and fro through the hole in the end of the bougie as over a pulley. The connection to the advancing end of the bougie of a small adjustable wheel (Fig. 772, *a*), around which the thread shall move, and the passing of the ends of the string through projecting arms provided with wheels (Fig. 772, *b*), facilitate the movements of the string. If a hollow bougie be employed, the apparatus can be simplified by carrying the ends of the string into the bougie through openings at the lower part, and thence upward and out of the upper extremity sufficiently far to permit of proper handling. In every instance the bougie should be a stiff one, and the end should not be carried far into the stricture before the string is brought into play. By this method of employment of the string the time of use is much lessened and the therapeutic effect greatly increased. It is not impossible, therefore, to reduce the stomach feature of the operation if desired from two steps to one, and perhaps in some cases to avoid it altogether, by this method of employment at either aspect of the obstruction, of string friction.

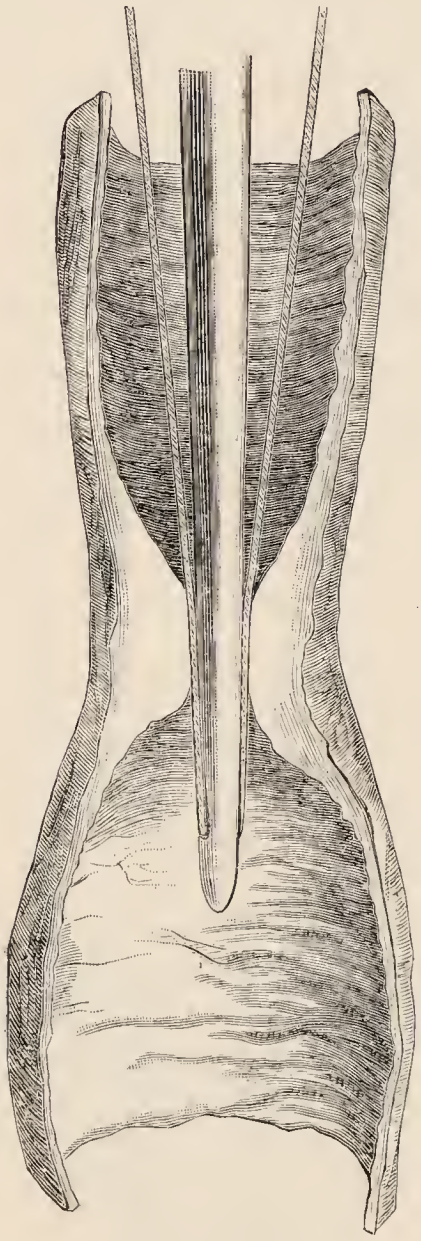


Fig. 771.
String friction employed through mouth only.




Fig. 772.
String friction appliance.

*The Comments.*—In the event of failure to dilate the stricture by way of the mouth the surgeon must supplement the effort by the advantages arising from the performance of gastrotomy or gastrostomy. The enfeebled condition of many of the patients with œsophageal stricture from lack of nourishment, and the tendency of obstinate strictures to relax after a longer or shorter quiescence of the tube, have led to increased frequency of employment of the latter plan, in order to permit of ample and immediate nutrition and to afford the rest to the œsophagus essential to stricture relaxation. *Silver* regards those cases characterized by impassible stricture and pronounced regurgitation—the latter indicating decided pouching of the œsophagus—as suitable for prompt gastrostomy. Cancer of the œsopha-

gus, especially, calls for early relief by this method. The opening into the stomach should be made of sufficient size to admit one or two fingers along with the necessary instrument for dilatation, and be placed well up on the anterior surface to permit of as easy access to the cardiac orifice as possible, and also to limit the danger of leakage during the manipulation. The borders of the gastric opening can be drawn apart by traction loops, to afford better observation, or they may be drawn by the loops closely against the exploring agent, thus lessening the danger of escape of the contents of the stomach. This opening may be closed independently of the abdominal one, provided dilatation sufficient to allow the ready passage of fluid food and the employment of bougies from above have taken place. The dilatation should be completed at a single sitting, if possible. If preliminary gastrostomy be performed, it is safer, other things being equal, that two sittings be given to the operation than that it be completed at one.

*The After-treatment.*—The passage of the largest bougies practicable once a week or once a month, according to the demands of the case, supplemented with the free use of solid food and the giving of exacting admonitions regarding the need of surgical surveillance for an indefinite time to come, are essential to final success.

*The Results.*—The results of retrograde dilatation are very satisfactory indeed. Woolsey reports twenty-eight cases "with no death due to the operation." To this number Silver has added ten with no change in the immediate results of the operation. The final outcome is much enhanced indeed by prompt resort to opening of the stomach. A steady and persistent loss of weight, due to obstruction in swallowing, forbids temporizing, and demands prompt and radical operative practice.

**Tubage with String Attachment.**—This plan is adapted to the treatment of malignant strictures, and is practiced on those patients in whom for any reason early gastrostomy is not practicable. While it is true that through the agency of tubage ample food may be taken for a time, also the saliva swallowed, and the objections to early operation condoned, still, the progressive nature of the disease causing the obstruction, the effect on the disease of pressure, and the dangers and annoyances of the introduction and retention of the tubes, especially in the advanced stages, together with the opportunity afforded for procrastination of operative practice until much too late for fitting success, suggest the fact that tubage, although an ingenious and sometimes temporarily useful means is, on the whole, a measure of questionable utility. However, the tube finds its most rational use in cases unsuited for operation. The method is practiced by introducing into the stricture by means of a whalebone conductor a funnel-shaped flexible gum-elastic tube with a string attached (Fig. 773, *b*) four to six inches in length, until the funnel rests above on the stricture. The lower end of the tube resembles that of the ordinary catheter, except the eye is made larger to permit the free passage of fluid food. The tube can remain in place often from one to two months without causing apparent trouble. The string escapes through the mouth and is carried over the ear for both security and convenience. It should be carefully guarded to prevent premature withdrawal of the tube

because of careless traction, and difficult removal on account of the breaking of the string. Sometimes coughing attends deglutition, and then the short tube should be replaced by a long one, which can be easily extemporized by cutting obliquely and closing the end of a suitable piece of red-rubber tubing, making the eye about an inch above the end, and introducing it through the stricture with a suitable conductor.

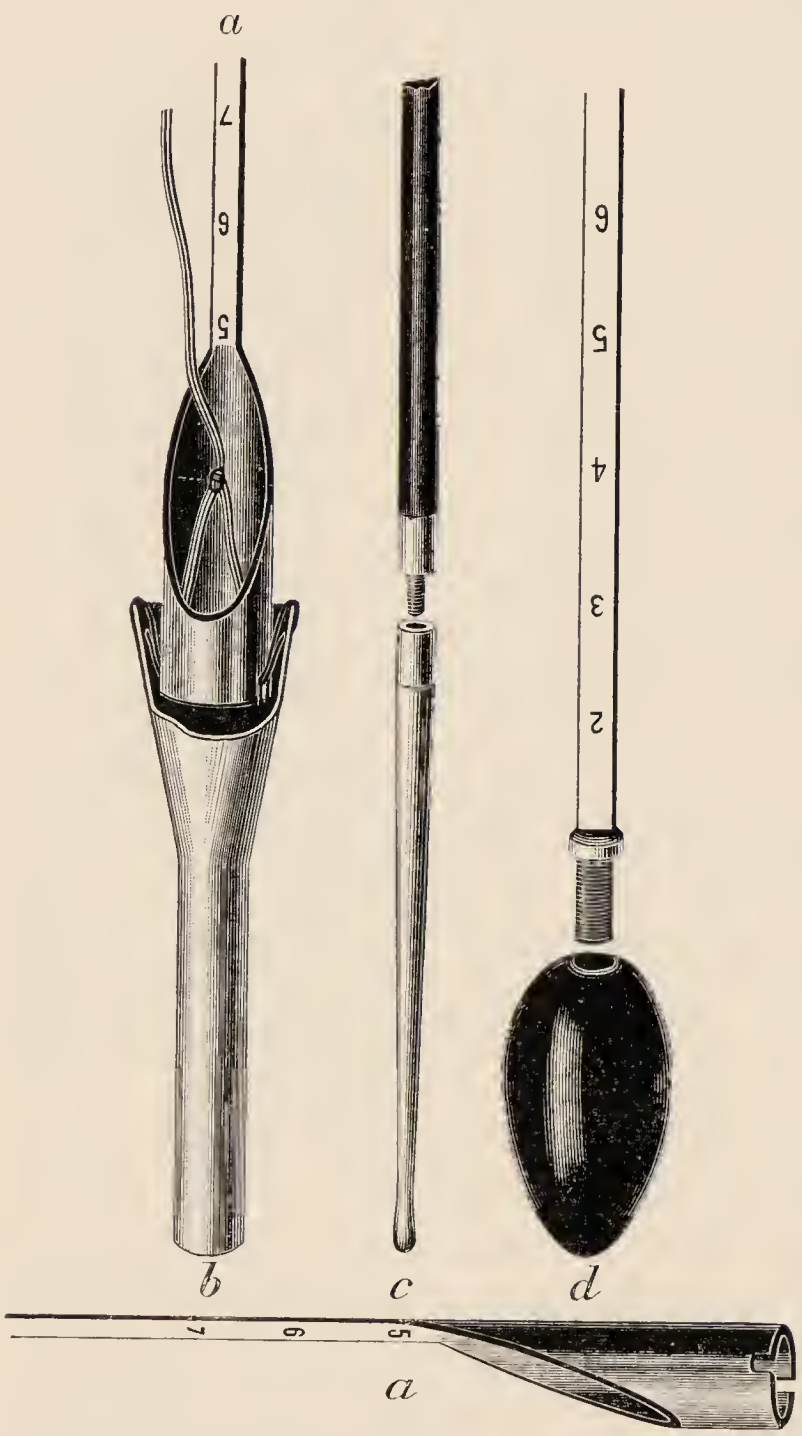



FIG. 773.—*a*. Tube conductor. *b*. Gum-elastic tube. *c*. Small flexible bougie. *d*. Bulbous bougie.

*The Results.*—Of seventeen cases treated by this method, nine died from the effects of the disease, without obstructed deglutition.

**Œsophagectomy.**—Œsophagectomy consists in excising a portion of the œsophagus through an incision made in the same manner as for cervical œsophagotomy (page 596) or for thoracotomy, for the removal of a cancerous growth. In the former the upper end of the lower portion of the tube is raised forward and united to the wound, thereby forming an opening through which food may be introduced by means of a tube. The latter method is noted under the proper heading (page 1046 *et seq.*).

*The Results.*—Only five or six cases have as yet been reported. In two of these life was prolonged for months; the remainder died soon after the operation. There is reason to believe that life can be prolonged for a greater length of time by feeding through a tube in the usual manner than by this procedure.

**Œsophagostomy.**—Œsophagostomy is employed to establish a fistulous opening with the œsophagus, below the point of an incurable, impassable constriction. It provides for the introduction of food into the stomach, and serves as a temporary palliative measure. While its adoption obviates for a time at least the performance of gastrostomy, still, there is no good reason to believe that it can be regarded in any instance as the wiser procedure.

## CHAPTER XIV.

### *OPERATIONS ON VISCERA CONNECTED WITH PERITONÆUM.*

It is eminently wise before considering the surgical treatment of wounds and diseases of the abdominal viscera, that a brief statement be made of the proper method of approach to the abdominal cavity itself.

**Abdominal Section, or Cœliotomy.**—Abdominal section is the opening of the abdominal cavity for the purpose of considering any of the various structures or pathological changes that may be present within. The situation of the incision will depend on the object in view and the importance of the tissues involved, the length will depend on the thickness of the wall, the desired freedom of manipulation, the character of the tissues, and the seat of the division.

*The Anatomical Points.*—The bony landmarks that skirt the abdominal wall are each important, and their individual significance should be well understood. The external oblique muscle is aponeurotic below a line extending between the anterior superior spines of the ilia, a fact which if unknown may lead to confusion in the identification of the respective tissues. The linea alba is broad above the umbilicus (Fig. 776) and narrow below (Fig. 777). The borders of one or both recti muscles are usually exposed in a median incision below the umbilicus. The pyramidalis muscle may be absent on one or both sides, double on one and absent on the other, and often greatly developed on either or both sides. The notch at the upper border of the pubic junction is the bony guide to the median line at that situation in the normal pelvis. The linea semilunaris lies at the outer border of the rectus abdominis, and extends in a curved direction from the tip of the ninth costal cartilage to the spine of the pubis, and opposite the umbilicus it is usually about three inches from the median line in the normal adult abdomen. However, if the cavity be distended, the distance is increased, as also are the width of the linea alba and the space between the recti below the umbilicus. The differences in direction of the fibers of muscles composing the abdominal wall and the presence of associated fasciæ, the opacity and density of the fascia transversalis, the loose fatty texture of the subserous tissue, and, if normal, the translucent and vascularized peritonæum, should each be noted for obvious reasons.

It is a noteworthy fact that important anterior branches of the dorsal and lumbar nerves run obliquely downward and forward between the muscular planes of the abdomen which they supply, and that their severance is followed by a greater or less loss of power of the muscles to which they are

distributed. Therefore, when possible, the abdominal incision should be so directed as not to expose the patient to the hernial sequels incident to the division of those nerves. Kelly calls attention to the presence in the subcutaneous fat, at a point of about an inch above the pubis, of a small transverse artery; also to one or more veins of considerable size, frequently found (80 per cent) lying on the peritonæum, behind the lower third of the linea

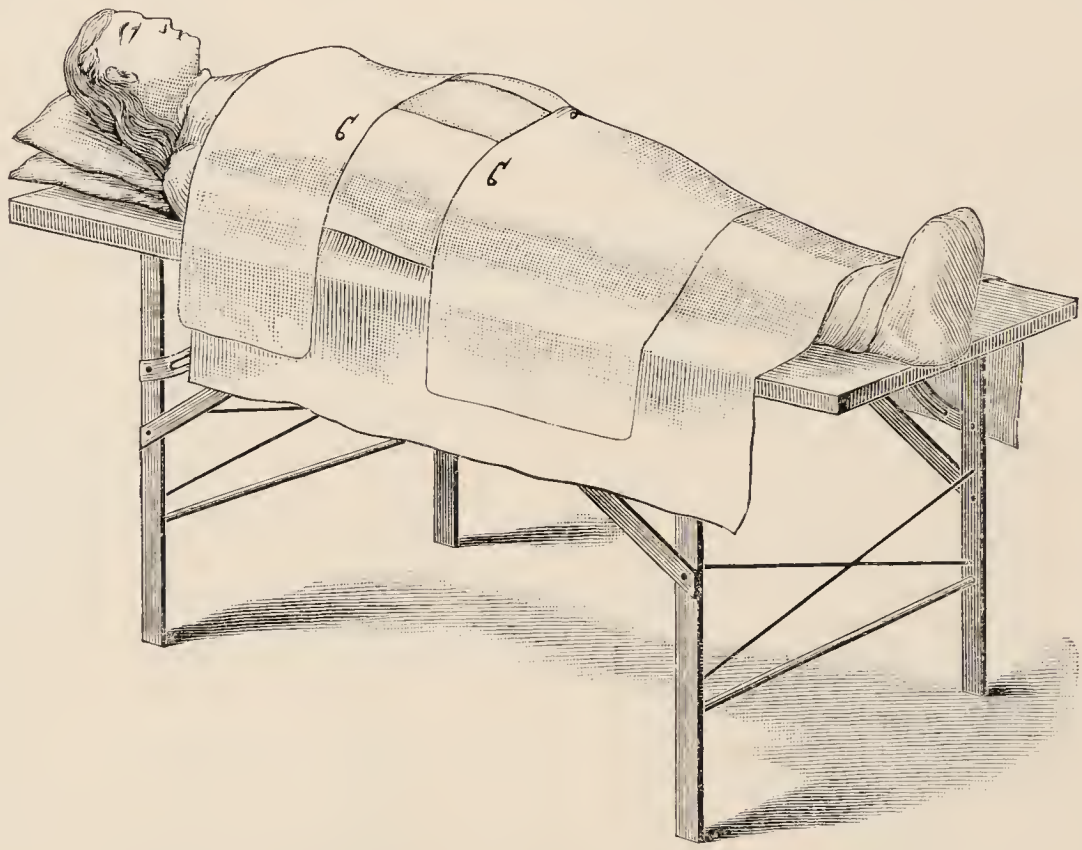


Fig. 774.—Patient prepared for abdominal section.

alba. The latter empty into the vesical plexus and are denominated by Kelly "the cœliotomy veins." Each of these vessels should be promptly and efficiently tied, when divided, to prevent the persistent bleeding that results from the fact of their free anastomoses.

*The Preparation of the Patient.*—The details of the preparation of the patient and the preparatory technique already stated (pages 7 and 99) should be carried into effect with scrupulous care. The bladder and alimentary tract should have been emptied some time before the operation. Place the patient on a well-drained, narrow table of convenient height and suitable mechanism, with the trunk and limbs outside the operation field well protected with warm, dry, aseptic clothing (Fig. 774). After thorough cleansing, the abdomen is surrounded with antiseptic towels, and the immediate surface itself is covered with antiseptic gauze until the beginning of the operation (Figs. 162 and 774).

*The Operation.*—Usually the incision is made in the median line below the umbilicus (Fig. 963). The character of the respective tissues is studied as soon as each is divided, in order to determine its individuality and the presence of the peritoneal tissue at once (Fig. 776). Aimless manipulation and unnecessary stretching of tissues should be condemned. Arrest hæmorrhage, seize a limited part of the peritonæum with thumb forceps, ascertain if it be free from subjacent tissue, then with a knife or scissors snip the portion grasped close to the point of seizure sufficiently to admit the entrance

of air and the introduction of scissors for the purpose of further division. When adequately incised to permit, pass a curved needle armed with a strong silk thread through the entire thickness of each border of the wound, and tie the threads in the form of loops (Fig. 44). These silken loops not only serve as traction loops, but they also prevent the stripping and displacement of the peritonæum from the adjacent tissues.

*The Precautions.*—Notwithstanding the fact that extreme cleanliness should be practiced in all operative procedures, in those directed to the serous surfaces, the vigilance and forethought of the surgeon should be of the highest order to prevent the possibility of infection. All matters relat-

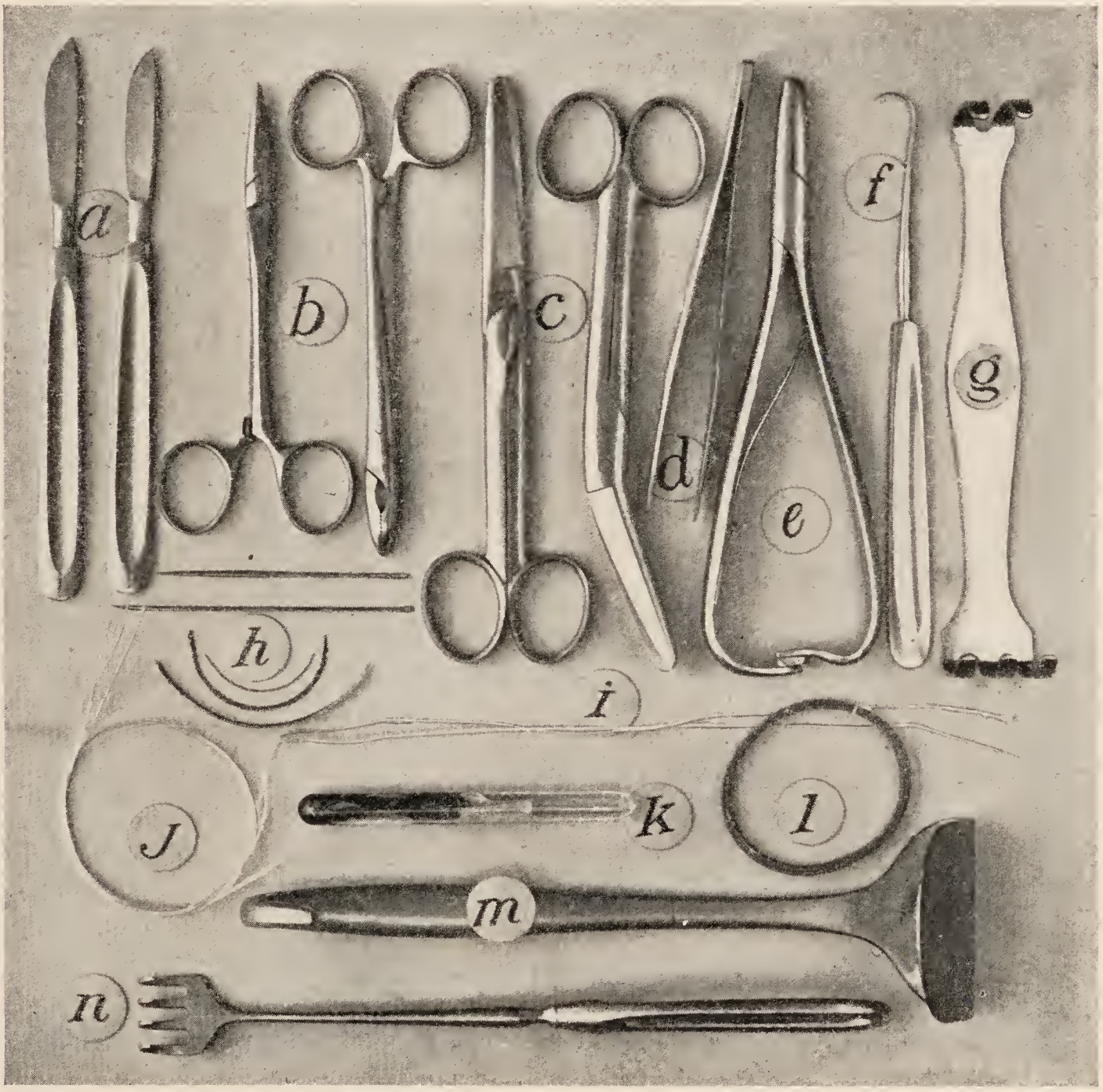



Fig. 775.—Instruments employed in abdominal section.

*a*. Scalpels. *b*. Forcipressure. *c*. Scissors. *d*. Thumb forceps. *e*. Needle forceps. *f*. Tenaculum. *g*. Blunt retractor. *h*. Needles. *i*. Traction loop. *j*. Silkworm gut. *k*. Chromicized catgut. *l*. Silver wire. *m*, *n*. Broad and hooked retractors.

ing to the operating room (page 7), the preparation of the patient, of the assistants, and of the surgeon himself, should be carefully considered and made to conform to the accepted standard of requirement of the time. In the event of the presence of visitors, those coming in close relation with the patient should not have been in recent contact with infecting agents or

diseases, nor should they meddle with contiguous objects. A safe rule of action is to keep the hands in the pockets and avoid textile contact with others unless properly clothed for the purpose.

*The Remarks.*—The seat of the incision is determined usually by the location and outline of the morbid process to be treated. The length of the incision is a matter of great importance, for if too short, observation and

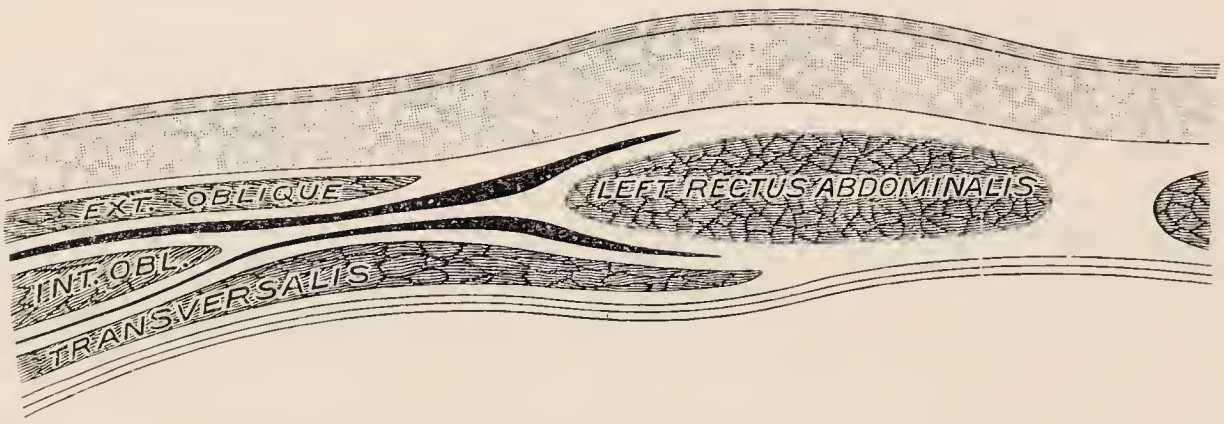



FIG. 776.—Arrangement of tissues corresponding to the upper three fourths of the rectus muscle (above the semilunar fold of Douglas).

manipulation by the surgeon are hindered, and the gravity of the procedure is enhanced because of the delay and damage arising from inadequate incision. If too large, needless exposure and escape of the abdominal contents will happen. Both primary and exploratory excisions should be made short at first, and be increased thereafter or changed in direction as circumstances require. In long incisions Kelly prefers division through the umbilicus, avoiding the suspensory ligament. In closing the wound in these instances he splits the umbilical tissue at either side to afford broader surfaces for approximation. Considerable time is taken by some operators in entering the abdomen, owing not infrequently to a want of confidence in their knowledge of anatomy and the fear of a precipitous entrance into the cavity. If, however, the primary incision be accurately located, and the succeeding tissues be divided directly downward in the same line, the deeper fasciæ and the peritonæum being in turn picked up at either side with forceps and raised, and the division made between the forceps, a prompt and safe entrance is easily accomplished. In the instance of adhesion between the parietal peritonæum and that of the subjacent viscera great caution must be exercised to avoid cutting the latter.

In those cases in which the contents of the pelvis and lower abdominal region are to be examined and treated, the elevation of the hips for a minute or so before and during the operation aids materially in the exposure of the parts, causing the intestines to retire upward toward the diaphragm. A further need of their withdrawal may be secured by the employment of retaining pads of aseptic gauze. If difficulty in breathing ensue or danger of the spread of infecting agents be enhanced by reason of the posture, it should be employed only with caution and in a limited degree. The rolling of the patient to one side, away from the seat of the disease, by means of mechanical adjustment of the table or by the hands alone, also favors examination of the affected site. The careful employment of broad retractors

and the use of a strong natural or artificial light are essential to the attainment of intelligent and efficient observation and treatment.

*Adhesions* are treated according to their density, length, vascularity, and the nature of the adherent surfaces, etc. If fragile, they may be readily torn by the finger or a sponge; if dense, they should be cut; if vascular, they should be tied before or after cutting, according to the size of the adhesion and of the bleeding point. The actual cautery may meet the indication, in some instances, of persistent oozing that resists sponge pressure, but the cautery ought to be used sparingly on account of its devitalizing influence. Strongly adherent parts of non-malignant growths may be left attached to an important viscus, especially after the adherent part has been reduced to a minimum by careful cutting or scraping. The serous covering of viscera, especially of the intestines, stomach, etc., should be treated with great care, otherwise this membrane will be stripped off, possibly destroying the nutrition of the wall at a circumscribed point, thus causing a slough, followed by peritonitis and death, or a persistent fistula. Surfaces thus exposed may be repaired with omental grafts or inversion and union of the serous borders with sutures. Adhesions may be so dense as to be irremediable. Omental adhesions can be readily stripped or tied off as their condition suggests.

*The Precautions.*—In omental oozing it is a quicker and securer method of practice to ligature and remove the omentum containing the bleeding area at once than to catch and tie separately the bleeding points. Adhesions should be dealt with under direct observation when possible, in order to note the presence of any ill effect from their rupture. It will be necessary for this purpose, in many instances, to spread out the adherent mass as much as possible before attempting the separation, which can then be done safely with scissors in the instance of fibrous bands.

*Hæmorrhage.*—The occurrence of persistent bleeding before or after the closure of the abdominal wound are often complications of profound signifi-




FIG. 777.—Arrangement of the tissues corresponding to the lower fourth of the rectus muscle (below the semilunar fold of Douglas).

cance, especially the latter. If all bleeding points be tied at once and oozing be arrested the dangers of this complication are reduced to a minimum. It is wise to restore the patient to the normal dorsal position, and perhaps to permit the return of the viscera to their normal relations in order that the influences of posture and warmth on their circulation may be estimated, and that any threatening outlook may be anticipated and remedied before the

final closure of the abdominal wound. If hæmorrhage happen afterward, prompt exposure of the field of operation, removal of the blood clots, and arrest of hæmorrhage is indicated. In such cases as these indecision and contentment on the part of the medical attendant contribute greatly to fatal issues.

*The Cleansing of the Peritoneal Cavity.*—Blood, urine, bile, fecal matter, diseased and septic products, etc., should be removed from the peritoneal cavity, when possible, with scrupulous care. While a considerable amount of blood may be absorbed and prove harmless under favorable circumstances, yet even the smallest amount may become the source of septic infection, especially if infecting influences be already present in the abdominal cavity. Flushing, wiping, and drainage, are the common expedients employed for cleansing purposes. An abundance of the hot saline solution (six tenths of one per cent); a weak solution (1 to 10,000) of corrosive sublimate or of carbolic acid (1 to 100); Thiersch's fluid; hot sterilized water, etc., have each been used for the purpose of flushing. However, the employment of the bichloride, carbolic acid, and similar solutions, is regarded with much less favor now than formerly, because of the proved deleterious effect exercised by them on the serous membrane, an effect that renders the membrane more vulnerable to septic influences. Latterly the hot saline solution has been generally employed for this purpose, not only because it is harmless *per se*, but also because it combats infection directly by its osmotic properties. *General flushing* should not be practiced for circumscribed infection, since this infection can be well treated by wiping and local flushing; and, too, the former plan of action will cause the dissemination of the infective material. General flushing must be practiced with great discretion and with reference to the demands of individual cases, for, as Treves wisely remarks, "It is quite as possible to do too much as to do too little." In general flushing, the borders of the wound are held upward and apart, and the fluid is poured freely into the cavity and allowed to flow out unhindered until it escapes unchanged in appearance. The cleansing effect of the fluid can be increased by agitating the abdominal contents with the hand, supplemented with alternating brisk pressure upon, or shaking of, the contents by external manipulation. If the patient be then turned to one side and held there cautiously for a brief time, nearly all of the fluid will escape. Finally, the portion remaining is caused to gravitate into the pelvis by raising the body upward to a proper angle and retaining it there while the fluid is removed as fast as it collects by careful sponging or siphonage. In so doing it is wiser to introduce a large sponge, which is removed as soon as it is well filled, squeezed, and again returned, as less friction will attend this plan than that of the repeated introduction of small sponges.

If infectious extravasation have occurred, the abdominal wound should be made large enough to afford prompt inspection and removal of the injurious agents, as the hindrance, delay, and imperfect opportunity for action in the presence of a small opening do much to prejudice the recovery of the patient. In these cases the intestinal folds should be raised and the hidden recesses carefully flushed to remove concealed infection. It should not be

forgotten that vigorous or repeated sponging or wiping with any agent exercises a traumatic effect on a serous surface, and, therefore, increases its vulnerability to sepsis. Sponging should not be hastily or needlessly employed. It is rare, indeed, in general septic peritonitis that general flushing can be properly practiced. The intestinal distention in these cases causes not only a prompt protrusion of the bowel through the smallest opening, but it likewise obstructs the introduction of the fluid and prevents the flushing of the infected surfaces. We know of no way of accomplishing thorough cleansing in this condition except it be by the removal and rinsing of the intestines outside of the body. Although by a course of this kind the intestines and abdominal cavity can be thoroughly cleansed, still, the return and retention of the overdistended intestines will be practically impossible unless their contents be discharged through free incisions at isolated points, which are closed by intestinal suture, a line of action which should be regarded as more vigorous than wise in the great proportion of such cases. *Localized flushing* is easily accomplished, owing to the fact that the infective influences can be quite well circumscribed by a wall of antiseptic gauze or sponges. In fact, the cautious surgeon will anticipate the escape and spread of infecting material in many instances by the establishment of a preliminary antiseptic environment.

*The Comments.*—The temperature of the saline solution should be about 112° Fahr., and the fluid should be poured carefully from a pitcher and directed in the proper course by the hand of the operator. The use of the hand in this connection is especially important, as the fingers can be more safely introduced and carried between the intestines than can inanimate objects; and, moreover, an improper temperature of the fluid is thus quickly noted. Still, the fluid can be discharged satisfactorily into out-of-the-way places, through straight or curved smooth glass or rubber tubes.

The serous fossæ associated with the cæcum, the kidneys, the beginning of the jejunum, the rectum, etc., need careful attention to determine the presence in them of infection, especially in instances of extended contamination. The leaving behind more or less of the saline fluid in the intestinal folds for the purpose of facilitating the resumption of their normal functions and the prevention of adhesions, and thus obviating their prospective entanglement, is often advised. While it is hardly possible to attach much practical importance to this proposition, owing to the rapid absorption of the fluid, still no harm need arise from its presence, and much good will attend the absorption because of the accompanying abstraction of infecting agents.

*The Drainage of the Peritoneal Cavity.*—If the surgeon could be assured of the absence of infection and of the nonproduction in the cavity of irritating products, drainage could be dispensed with. Owing, however, to the difficulty of removing entirely from the peritoneal cavity the infectious elements incident to the presence of pus, putrid fluids, etc., and the liability of the production of fluids from injured surfaces in excess of the power of absorption, it is wise to forestall possible disaster or subsequent reopening of the cavity by the employment of adequate drainage. If one be in

doubt regarding the advisability of drainage, then, indeed, it should be practiced, as but little harm can arise from the proper use of drainage agents as compared to that resulting from its need. Textile fabrics and rubber and glass drainage tubing are the agents in common use. Rubber and glass tubes serve to collect the discharges rather than to expel them from the wound; however, when thus collected the discharges are removed by suction with a small syringe armed with a rubber tube. Not infrequently textile fabric is introduced into, and sometimes around, a glass drainage tube (Fig. 778), thereby substituting for the syringe the influence of capillarity, and thus lessening the dangers of infection from without. Since the textile fabric acts by capillarity, its efficiency is increased by a parallel arrangement of its fibers. In all instances the drainage agents should be carried to the bottom of the most dependent parts, as superficial drainage alone is both deceptive and ineffectual. Antiseptic candle wicking and gauzes are in common use for the purpose. It should be emphasized that the *packing* of a wound with gauze hinders rather than facilitates the escape of the discharges; therefore, textile-fabric drainage should be arranged loosely and carefully in as direct a manner as possible from the site of beginning to the external surface of the body. This variety of drainage can be inserted between the intestinal folds in various directions. In order that the wound be not infected from without on account of the drainage tube, the external opening must be carefully closed with antiseptic gauze or sponge during the intervals of cleansing. The syringe, too, should be carefully guarded against contamination. Ordinarily, drainage can be dispensed with in two or three days. By this time, in many cases, the intervention of fibrinous products caused by serous contact with the drainage agent will have reduced the efficiency of drainage at the original site to a minimum.

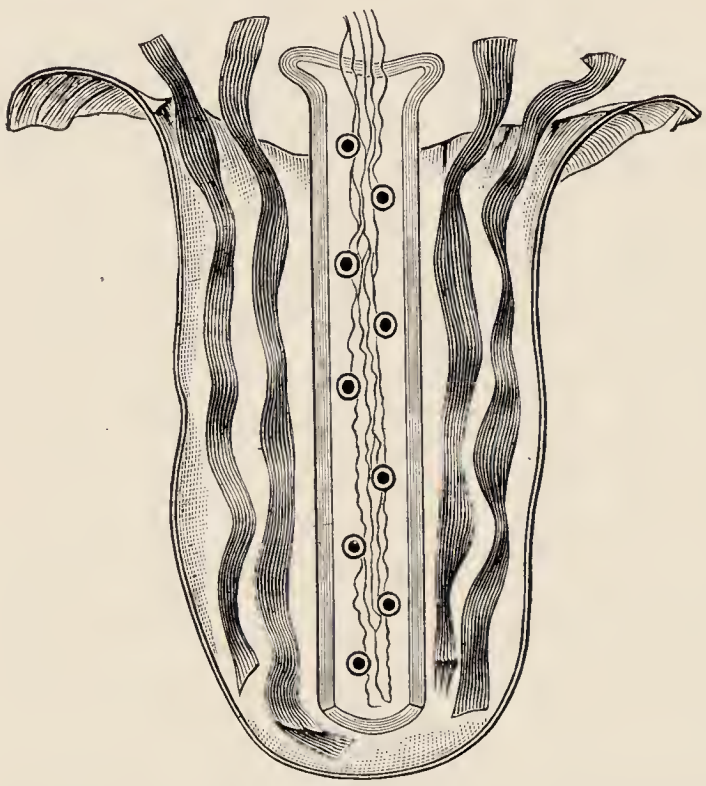


Fig. 778.—Perforated glass tube containing textile fabric.

*The Remarks.*—The absence of organisms in the field of operation, as determined at the time by the microscope, should be regarded as contraindicating drainage. Kelly omits it in gynæcological cases, even in the presence of a small number of germs, with satisfactory outcome. However, when for any reason the circulation of the intestines is impaired, interfering with their powers of absorption and elimination, the employment of drainage is advisable, and especially so in the presence in the peritonæum of infecting agents. Pieces of gauze fifteen to twenty inches long and two or three inches wide, so folded, with the edges inturned and sewed, as to prevent raveling, are suitably constructed drainage agents. These drains are made of plain or sterilized and principally of iodoformized gauze. In the latter it is

wise to wash out the excess of iodoform with sterilized water before introduction.

The late Dr. Van Arsdale expressed great appreciation of the drain made of plain gauze saturated with sterilized oil, claiming for it a high degree of absorptive power, easy introduction, and safe and comparatively painless removal. The surrounding of textile-fabric drains with aseptic perforated rubber tissues prolongs their efficiency and facilitates their removal. Pieces of this tissue loosely rolled are serviceable drains, and are easily removed because of little adherence to the serous surfaces. The introduction into the abdomen of a drain should be done in a manner best designed to facilitate drainage and to favor easy and safe removal of the drain. The aggregate of the textile fabric employed is regulated by the size of the area to be drained and the prospective amount of the discharge. Packing the wound hinders proper drainage and ought not to be done except to control hæmorrhage.

The drainage agents should extend from the infected parts by the shortest practicable routes to without the abdomen. If the infection be extensive the number of the drains should be increased and allowed to escape at different aspects of the abdominal wall, usually at the sides. In all instances, where practicable, dependent drainage should be established. The outer ends of the drainage agents and the openings transmitting them are a constant menace to asepsis; therefore they should be protected by an abundance of gauze which will at the same time aid materially the functions of the drains themselves. The gauze should be changed as soon as it is wet with the discharges.

*The Precautions.*—Gauze drains, especially the iodoformized, should be twisted quite vigorously until loosened before withdrawal is attempted, and even then it is quite painful. When gauze packing is employed it should be introduced first around the outer border of the bleeding area, thence toward its center, thus permitting of its easy removal from the center toward the periphery. This variety of drain especially should not be placed in contact with the ligatures or lines of delicate sewing, because of its tenacious adhesion to contiguous structures and the consequent liability to hæmorrhage and tearing on removal. Ordinarily the need for drainage is met in two or three days, when the agent should be removed, for delay provokes increased discharge, exposes to infection, causes ulceration, and lays the foundation for sinus formation, intestinal obstruction, and hernial protrusions. The threads liable to detachment from a drain should be removed and the borders turned in and securely sewed, otherwise they will become detached from the drain and remain in the wound, causing abscess, and perhaps fatal sepsis.

*The Closure of the Wound.*—A thin, wide sponge or broad gauze "wiper" (Fig. 66) should be placed on the abdominal contents before closing the wound, to prevent the escape of the intestines and absorb such fluid blood as may come in the way. Two methods of closure of the borders of the wound are practiced: 1, in which certain tissues are joined independently with each (Fig. 779) other—i. e., tier suturing (Fig. 780); 2, in which the borders are

joined as a whole, sometimes called suturing *en masse* (Fig. 781). In the former the serous and fascial tissues may be united independently with a continuous suture, then the subcutaneous fat, and finally the integument are similarly united, thus introducing four lines of sutures; the number can be increased or diminished as suits the surgeon. In the latter method the borders are transfixed with a long needle carried at either side from within outward, therefore requiring a needle at each end of the suture. Although this plan of introduction is the better one, still, the transfixion is often made from right to left, or the reverse, with a single needle, the first border being pierced from without and the last from within, both including, perhaps, the peritonæum of the respective sides. The requisite number of sutures—about three fourths of an inch apart—should be placed before any are tied, unless the wound be a long one and intestinal protrusion be pronounced, then one or more of the upper sutures should be tied at once to reduce the size of the opening. The final outcome of the two methods of procedure is of obvious importance. In the first method less than six per cent experience hernial protrusion; in the latter a greater number are said to suffer sooner or later from this infliction.

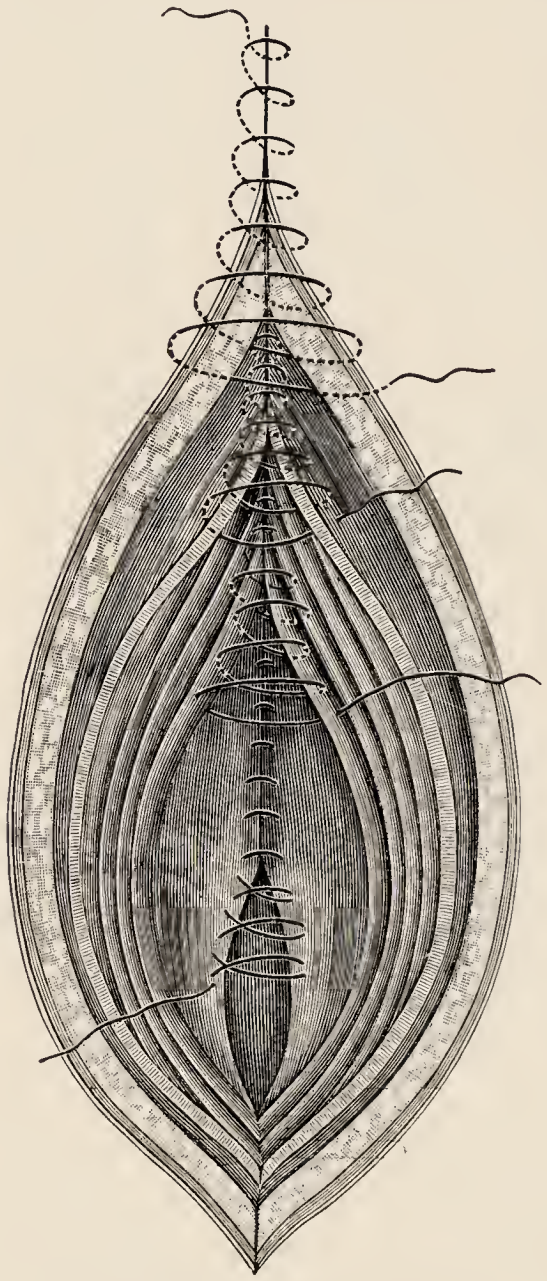


Fig. 779.—Tier suturing.

*The Comments.*—In either method of sewing, room should remain, when needed, for the exit of the drainage agent, which is usually placed at the most dependent part of the incision. The sutures should be tied from above downward, the sponge or gauze being removed while sufficient room yet remains for its exit. The air within the peritoneal cavity should be expelled by pressure before complete apposition is made of the peritoneal borders. Silkworm-gut, silver-wire, catgut, and silk sutures are used according to the fancy of the surgeon, the first two being preferable in most cases of heavy sewing. A close apposition with each other of the divided borders of the respective tissues is essential to the final security of the line of union. Catgut sutures are commonly employed in sewing the peritonæum; silver wire and chromicized catgut in sewing the fascial and aponeurotic tissues; chromicized catgut and silk the muscular; catgut the adipose, and silkworm gut and catgut the cutaneous tissues. The mattress and subcuticular sutures are suited to the fascial and subcutaneous structures respectively.

*The Precautions.*—The borders of the fascia retract considerably on division, and may therefore escape notice and remain ununited, thus contributing greatly to adhesions and hernial sequels. They should be secured and carefully united with each other in order that firm union shall be estab-

lished. The bleeding points of the subcutaneous fat especially should be looked for and securely arrested to avoid subsequent flow and the formation of hæmatoma and its sequels.

*The Treatment of the Wound, etc.*—The wound is cleansed and several layers of sterilized gauze, large enough to extend four or five inches beyond the borders of the incision, are applied. Silver-foil films are directly applied and held in place with gauze and adhesive strips in subcuticular sewing (Halsted). Abundant layers of sterilized cotton or "combination" (page 94) are placed over the primary dressings. The whole is confined firmly in place by means of a single broad body bandage, or by one of the many-tailed pattern. In either instance the lower borders will slip upward unless confined by means of perineal straps. The binder is applied, having an opening for the end of the tube, the tube protected, and the patient placed in bed. Bottles or other receptacles filled with hot water and carefully surrounded with flannel are placed at the patient's side and between the limbs, if circumstances demand their use.

*The After-treatment.*—The patient is kept quiet on the back, thirst is relieved with hot saline enemata, the bladder is emptied with a catheter, light food is given, the temperature and pulse are recorded, and otherwise carefully watched. Constipation is treated with salines and enemata, flatulence, with carminatives and the rectal tube. Unless specially indicated the wound is not dressed till the fifth or sixth day, and again in two or three days thereafter, at which time the stitches are removed, and, if need be, the abdomen is supported with strips of adhesive plaster and a binder. The bodily comfort of the patient should be considered from the outset by encouraging change of posture in bed, the use of baths, and fresh linen. The patient is permitted to get up at about the end of the fourth or fifth week, and for some months thereafter an abdominal supporter may be worn, especially by fleshy patients.

*The General Comments.*—The opening in the peritonæum should be made small at first, only large enough perhaps to admit the index finger;

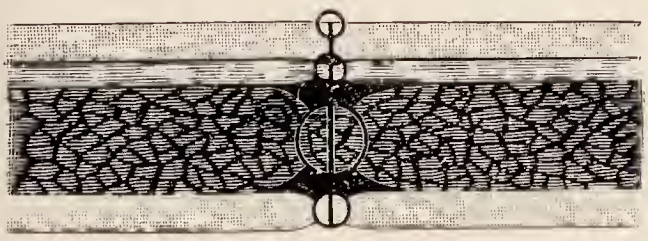


FIG. 780.—Tier suturing, transverse section.

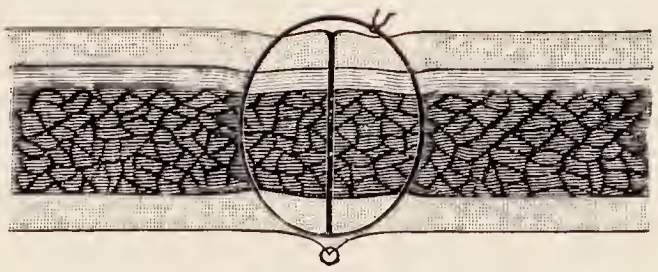


FIG. 781.—Suture *en masse*, peritonæum sutured independently.

later, however, it should be increased to meet the demands of explorative and operative technique, without unnecessary delay or the employment of undue force. A large sponge introduced into the pelvis, and numerous small ones placed at the borders of the operation field, will absorb the fluids associated with the operation, and additionally the latter should prevent the escape of the intestines and their contact with deleterious agents. Injury to the ureter, intestine, gall bladder, etc., should be carefully avoided, and when inflicted prompt repair should be practiced.

*The Fallacies.*—The aponeurosis of the external oblique may be mistaken for fascia, and consequently the internal for the external oblique, and so on, causing much anatomical confusion. The transversalis fascia may be mistaken for the peritonæum, and, therefore, the subserous tissue for the omentum, and possibly the gut for the peritonæum itself; and especially is the last fallacy liable to present if the intestine be adherent to the parietal peritonæum. The number of the sponges and all other agents employed in direct connection with abdominal section should be accounted for before the wound is closed, otherwise they may remain behind in the cavity and lead to fatal results. The bladder may be incised if adherent to the wall or filled with urine, hence it should be emptied, and, if a doubt as to its location arise, its limits should be outlined with a sound at the time of operation.

*The Results.*—The results will be stated in connection with the special objects for which the abdominal section is made.

**Explorative Abdominal Section, or Explorative Laparotomy.**—The abdominal cavity is frequently opened for the purpose of ascertaining the cause of diseased manifestations, and with the view of applying the surgical remedy, therefor, if feasible; but if impracticable, the incision is usually promptly closed. The technique of the explorative section differs in no essential manner from that already stated. The incision is usually made over the seat of the trouble.

### OPERATIONS ON THE INTESTINES.

It is important in operations on the intestines to observe the following considerations with great care: 1. The avoidance of all unnecessary hæmorrhage. 2. The prevention of the escape of irritating matters into the abdominal cavity. 3. The union of the divided borders so that they will remain properly joined and result in perfect repair. 4. The avoidance of unnecessary shock and of the retention of septic and irritating influences.

*The first indication* is met by the avoidance of incisions through the lines of the established course of vessels, and by the use of needles which do not possess cutting edges.

To meet *the second indication* requires a great degree of care irrespective of the knowledge of any established measures. The lips of the wound should be cautiously guarded by various expedients. If the nature of the case will permit, the contents of the viscus should be removed or pushed aside before the incision is commenced, and at all times the serous surfaces must be protected from contact with irritating matters, by means of broad, thin, aseptic sponges, or pads, moistened in a warm, mild, aseptic fluid.

To fulfill *the third indication*, sutures of various forms and methods of application are employed, the aim of all being to bring the serous surfaces in contact, and maintain them so until firm union is established (Figs. 782 to 860). When possible, a wound of the intestine, however small, should be closed, to prevent the escape of irritating matters into the abdominal cavity.

*The fourth indication* is very important, especially if the operation be prolonged and tedious, or if it be necessary to remove the intestines from the cavity of the abdomen. The room in which operations on the abdom-

inal contents are performed should be thoroughly cleansed and fumigated when possible, and in every way made aseptic. If the temperature can be raised to about 90° F., and the atmosphere moistened with vapor, the surroundings will be much improved, especially for cases in which the abdominal contents are long exposed. If the intestines be removed from the cavity, they must be surrounded by sterile cloths saturated with hot (112° F.) aseptic fluids, preferably the saline solution, and kept warm and moist by repeated applications of the same until they are replaced. The "toilet" of the abdominal cavity must be cautiously and perfectly made before closure, and suitable provisions for drainage established if pernicious secondary local processes be apprehended.

**Intestinal Sutures.**—The varieties of intestinal suture are numerous, ingenious, and effective, but often too complicated to be practicable for the use of others than those who designed them. Our aim, therefore, will be to describe those only that have the sanction of practicability established by experienced use. Straight needles that displace and do not cut the tissues in the passing are employed in intestinal sewing, the common cambric needle being a good illustration of the kind. Silk is of accepted use in intestinal sewing. It should be of sufficient strength to permit of proper apposition of the surfaces, and colored to enable the operator to define easily the exact location of the sutures. The fine iron-dyed, twisted kind is very satisfactory in these respects. Fine catgut is sometimes used instead of silk, but is much less reliable. Stronger and coarser silk than the preceding is employed in common sewing and in the ligature of vessels. A still greater increase in these characteristics is needed in the ligatures applied to large masses of tissue, pedicles, etc. The braided and cable-twist varieties are the strongest, the latter being of American and English manufacture, and the former of these is the weaker of the two. It is to be regretted that the

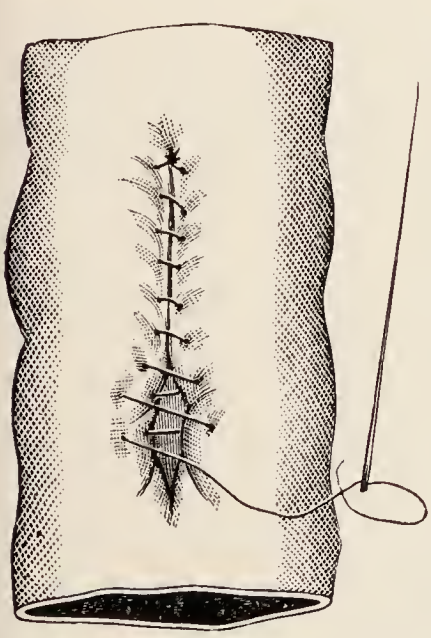
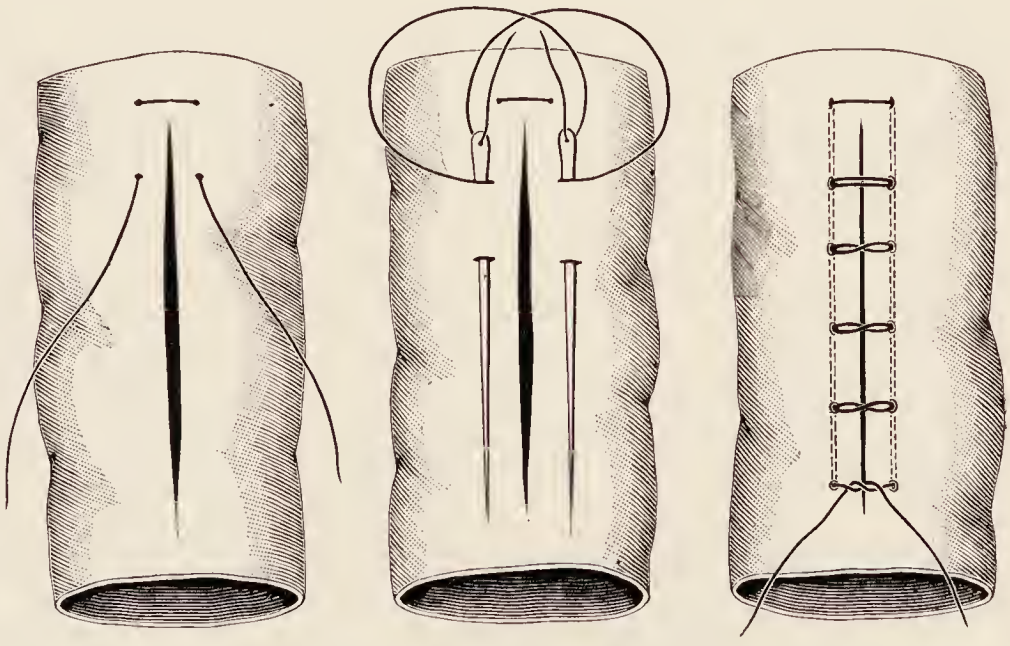


FIG. 782.—The continuous suture.



*a* *b* *c*

FIG. 783.—The Gely suture, external appearance.

standards of size of silk are not so definitely classed as are those of wire, for then silk could be ordered with a certainty of return that now can be secured only by the sending of a sample of the required size.

*The Precautions.*—Unless the strength of silk be tested before it is used it may break when applied, causing delay and confusion and perhaps impairing the work of the surgeon. Sutures, especially of silk, passing unhindered through the mucous and serous surfaces of intestines are liable to infect the latter surface by capillarity. Hence the sutures should include the serous, muscular, and submucous fibrous coats, the mucous being omitted in all instances of direct serous sewing, and if for any reason the mucous coat be then included, a supplementary superficial stitch of the serous membrane should be made to complete the union. The serous surfaces should be brought in contact with each other before transfixion by the turning in of the borders, as indicated in the illustration (Fig. 782).

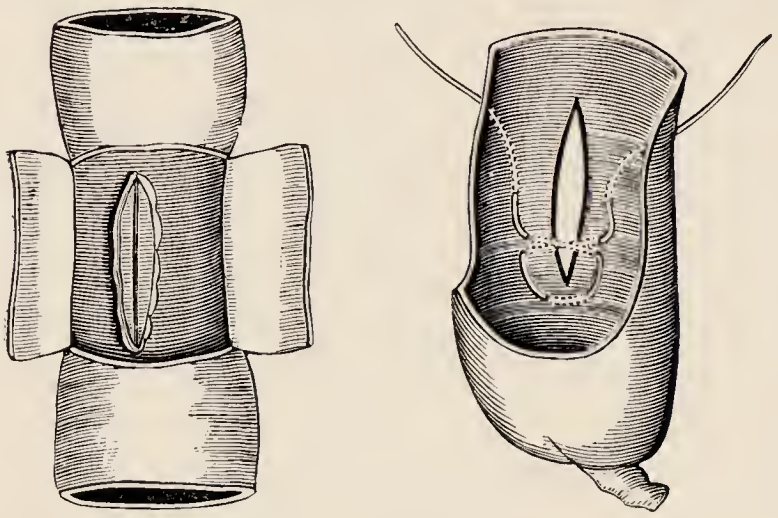


Fig. 784.—The Gely suture, internal appearance.

*The Continuous Suture* (Dupuytren) (Fig. 782).—The name of the suture defines its arrangement. This form is exceedingly useful in joining the borders of long cuts of either a serous or cutaneous surface. In the former the stitches are placed closer together than in the sewing of cutaneous surfaces, and the cut surfaces of the wound are brought directly in contact with each other.

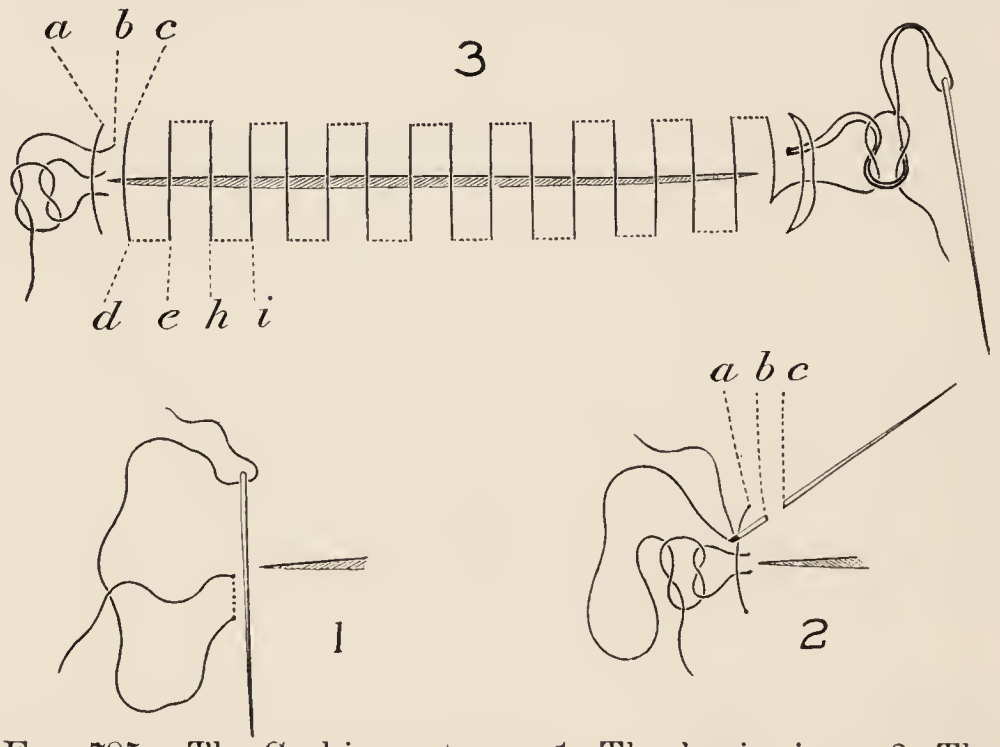



Fig. 785.—The Cushing suture. 1. The beginning. 2. The knotting 3. Suture applied. *a*, *b*, *c*, in 2 and 3, indicate needle punctures. *d*, *e*, *h*, *i* indicate track of needle.

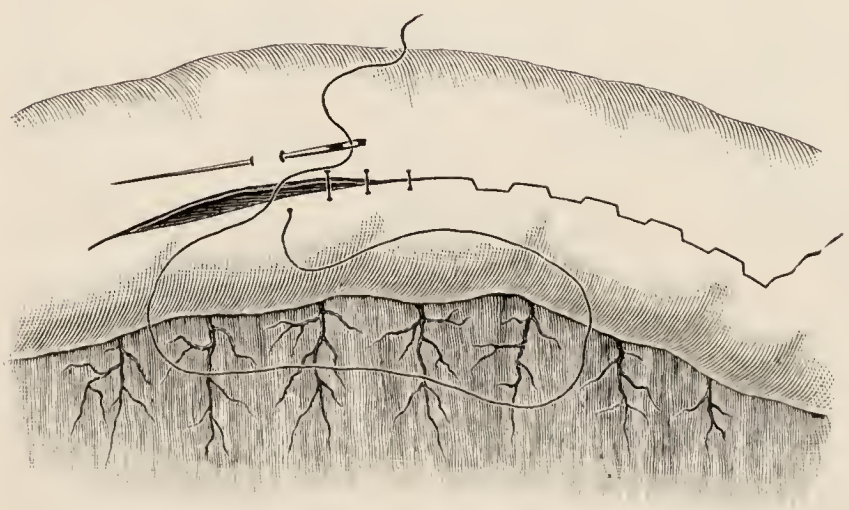


Fig. 786.—The Cushing suture, closing wound.

*The Gely Suture* (Fig. 783).—In Gely's method a long suture is selected and armed with a needle at each end. The needles are inserted near one angle of the wound, about two lines from the edges, and carried along the tissues of the bowel for a sixth of an inch, then brought out precisely on the same level, so as to again

appear on the peritoneal surface (*a*). The sutures are then crossed, and the needles passed as before (*b*). If a knot be made at each crossing, slipping of the sutures will be prevented (*c*). The number of the crossings will vary with the size of the cut. By this method the edges of the wound are thoroughly inverted (Fig. 784), and all danger of extravasation is prevented. This suture is not frequently employed, and although a good one is not as readily understood nor so promptly applied as are the following. It is sometimes described and figured as including the mucous membranes, a step that ought not to be practiced.

*The Cushing Suture.*—In this suture the needle does not enter the cavity of the gut, but instead it includes the serous, muscular, and submucous fibrous coats. The sewing is commenced as shown in Fig. 785. The thread is knotted and the stitches are taken in the manner indicated, and when the thread is drawn tight the wound is closed and the suture is buried (Fig. 786). The final tying is illustrated also (Fig. 785).

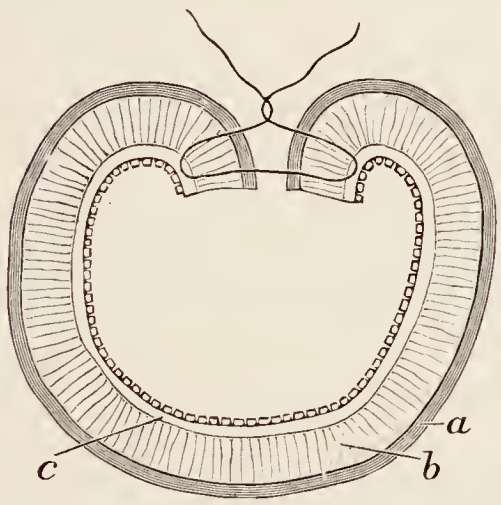



Fig. 787.—The Lembert suture. *a*. Serous coat. *b*. Muscular coat. *c*. Submucous fibrous coat.

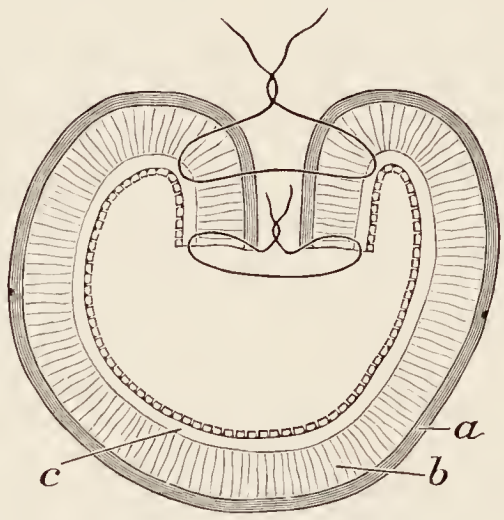



Fig. 788.—The Czerny-Lembert suture. *a*. Serous coat. *b*. Muscular coat. *c*. Submucous fibrous coat.

*The Lembert Suture.*—By this method the serous borders are infolded (Fig. 787) and the sutures are passed through them at about a tenth of an inch from the edges of the wound, being placed about the same distance apart. The number of stitches and the amount of tissue included will be governed by the thickness of the tissue and the strain exercised. The rapidity of intestinal sewing can be increased if four traction sutures be inserted, two on either side of the divided gut in the line of the tissues to be stitched. These pairs of sutures, one at either end, are made tense in opposite directions, thus raising parallel folds of serous membrane through which the intestinal sutures are passed (Fig. 869).

*The Czerny-Lembert Suture* (Fig. 788).—Two rows of sutures are employed in this method, neither of which, however, is passed through the mucous membrane. The first, the deep series, brings the edges of the mucous membrane together; the second, the Lembert, are passed as before indicated. The introduction of the first series is materially aided by the eversion of the mucous membrane. After rectification of the walls in end-to-end sewing, the majority of the knots should be within the bowel; in the closure of small wounds they are without.

*The Wölfler Suture.*—Wölfler joins the divided ends of intestine by two rows of interrupted sutures. The first, the outer, row includes the serous and muscular structures (Fig. 789), the second, the inner, includes the mucous and submucous tissues (Fig. 790). The sutures are tied internally

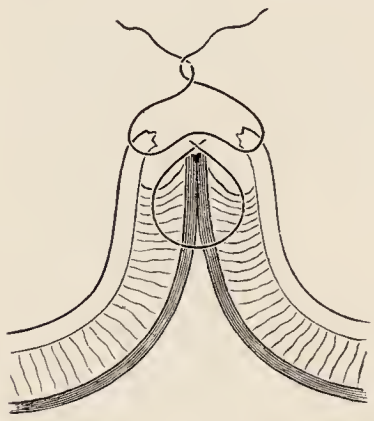


Fig. 789. The Wölfler suture, sectional view.

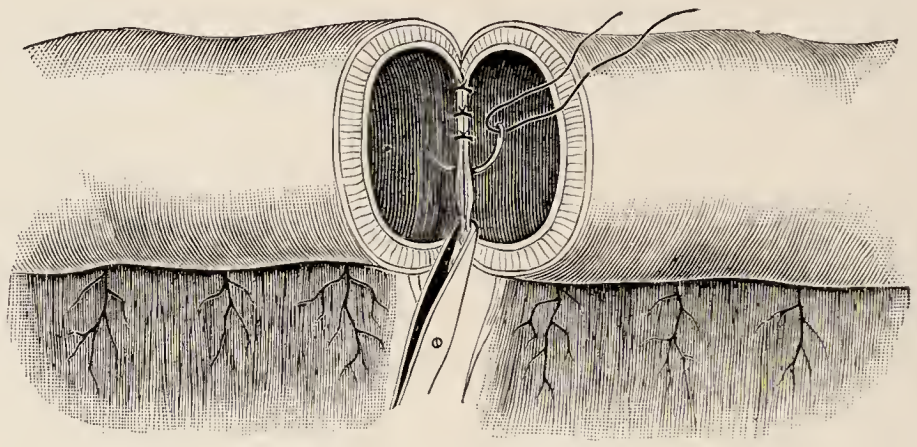


Fig. 790.—The Wölfler suture, joining the mucous and submucous coats.

throughout except the last few. The direction of the manipulations in these latter is reversed for obvious reasons.

The Jabouley-Briau suture differs in the construction from the preceding in no important practical respects.

*The Gussenbauer Suture.*—By this form of suture the submucous, fibrous, and serous tunics of the intestine are brought in place at once

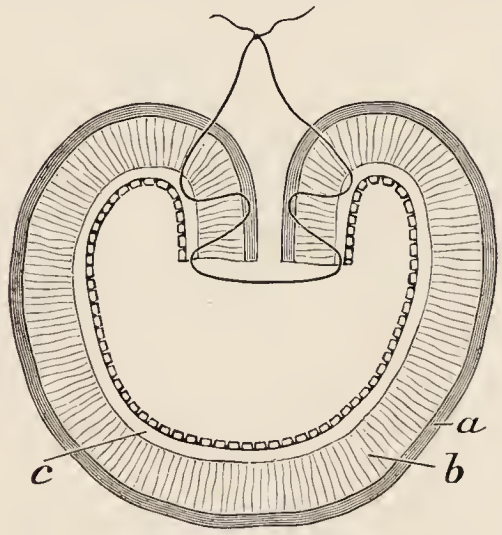



Fig. 791.—The Gussenbauer suture.

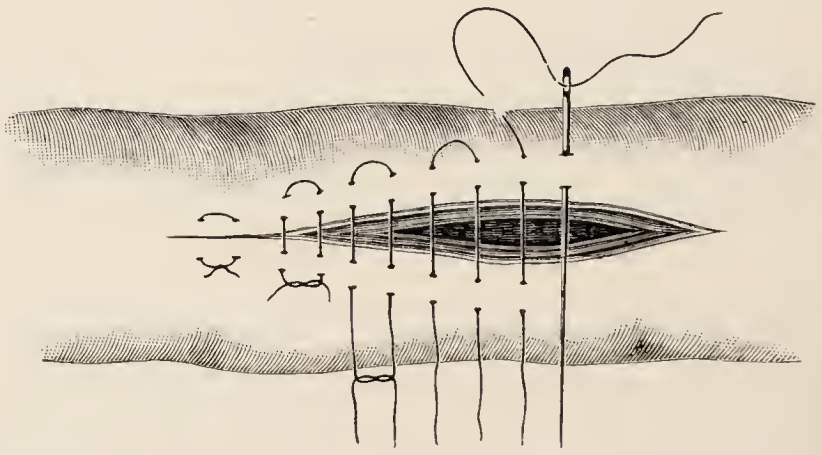


Fig. 792.—The Halsted suture, closure of longitudinal incision.

(Fig. 791). However, this stitch is complicated and somewhat tedious, and affords no additional security to repay for the slowness of execution and difficulty attending its use.

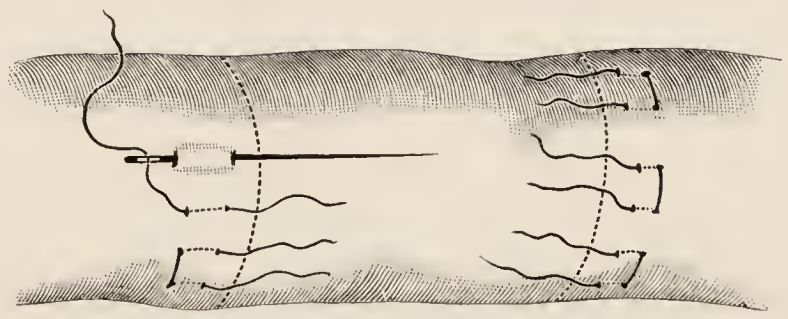


Fig. 793.—The Halsted suture, end-to-end sewing.

*The Halsted Suture* (*Mattress or Quilt Suture*).—The stitches of this suture are of the nature of the Lembert. They are passed so as to include some of the tough, submucous fibrous coat (Fig. 792). Tying should be omitted, when practicable, until all of the stitches are in place.

*The Jobert Suture.*—Jobert's suture is employed to unite the divided extremities of a bowel. Identify the proximal and distal ends by examina-

tion and by Nothnagel's test—chloride of sodium causes reverse peristalsis—dissect away the mesentery for a third of an inch from either end of the gut; transfix the proximal end with one needle armed with a long suture at the site of mesenteric attachment (*a*) and with another at a point in the border opposite to it (*b*) (Fig. 794); invert the margin of the distal end (Fig. 795); introduce two sutures

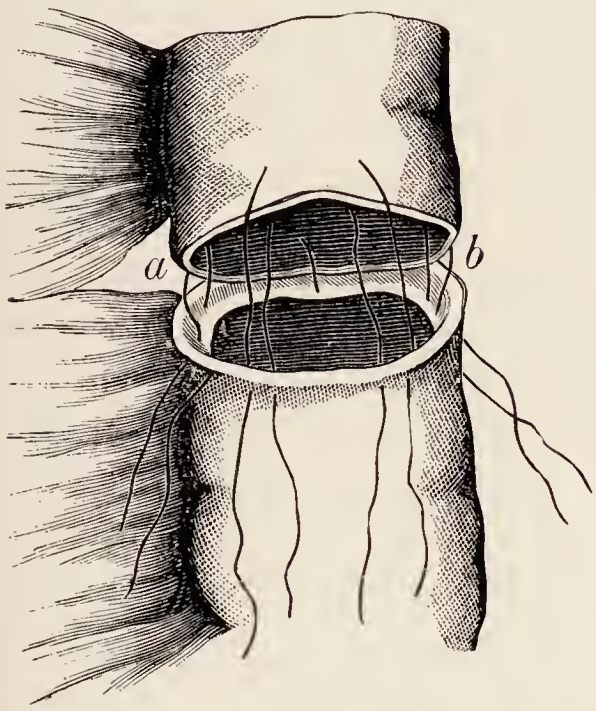



Fig. 794.—The Jobert suture, bringing ends together.

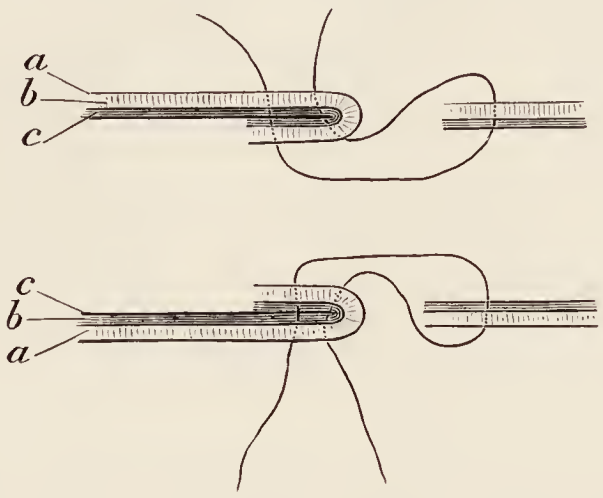



Fig. 795.—The Jobert suture, longitudinal section. *a*. Peritoneal. *b*. Muscular. *c*. Mucous coats.

at either side of the gut in a similar manner; arm each end of the ligatures with a needle, and transfix from within outward the inverted portion at points corresponding to the sites of transfixion of the proximal end; draw the upper end of the bowel into the lower and tie the sutures at the outer side (Fig. 796). When necessary a greater number of sutures may be applied in a similar manner and tied (Fig. 797). This course adds greater security to the union. The application of continuous sutures to the line of junction should be avoided, as the sewing will interfere with the nutrition of the inverted part still more and increase the danger of sloughing that exists already in a certain degree. An occasional interrupted suture (*a*) may be inserted to strengthen the union.

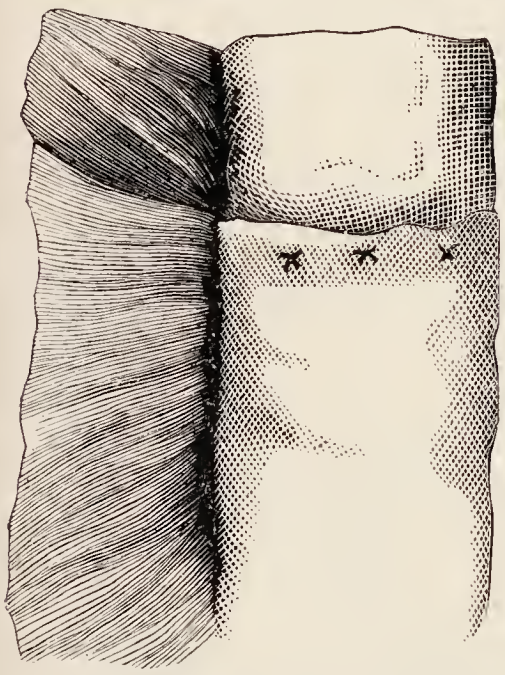


Fig. 796.—The Jobert method, sutures tied.

*Senn modified this method* in a very important manner. Into the upper end of the bowel he introduced a common soft-rubber band of the length of the width of its caliber and joined it to the margin of the bowel with a continuous fine catgut suture, thus preventing the protrusion of the mucous membrane and causing the end of the gut to assume a tapering appearance. Two fine catgut sutures are then passed from within outward at opposite sides of the bowel, as in the preceding method, transfixing the rubber ring and the wall of the intestine (Fig. 798). Both ends of these sutures are

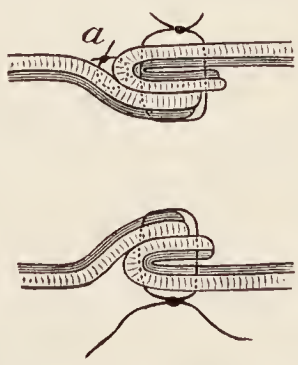



Fig. 797.—The Jobert suture, fixation sutures tied. *a*. Interrupted suture.

then caused to pass from within outward through the serous and muscular coats of the distal end of the bowel about a third of an inch below the margin. The upper is then drawn carefully downward into the lower extremity by aid of the sutures, while the margins of this latter extremity are cautiously inverted with the aid of a director or probe. The sutures are tied as before, no additional ones being regarded as necessary. The rubber ring serves the important purpose of facilitating the invagination, of easing the suture tension, and obviating capillary drainage of the sutures themselves. Sooner or later the ring comes away in the natural form. An ordinary rubber band, shortened by tying the ends with catgut, will suffice for the purpose.

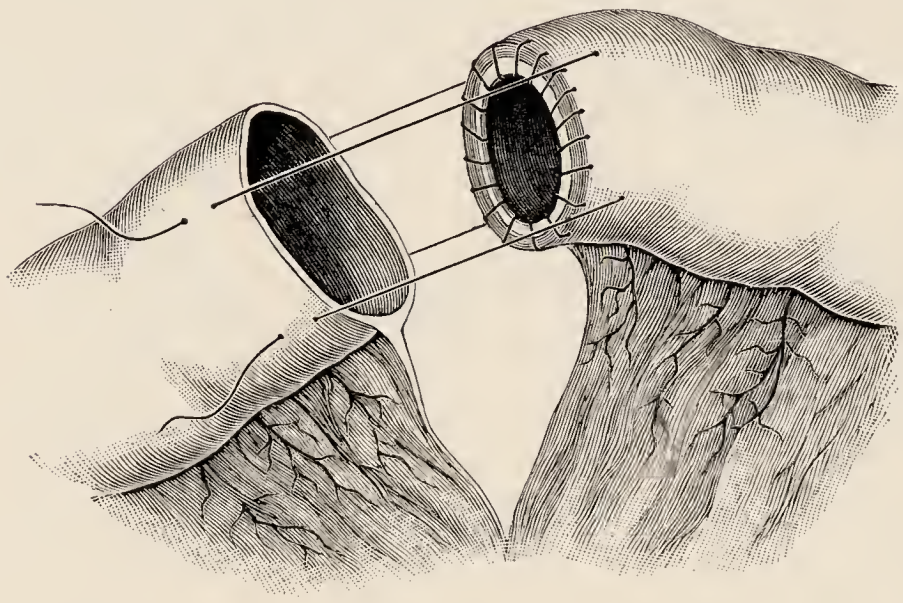


FIG. 798.—Senn's modification of Jobert's suture. Rubber ring sewed in position.

*The Remarks.*—The Lembert, Cushing, and Halsted sutures can be applied by those of comparatively limited experience, and neither of them encourages infection by capillarity. The remaining varieties are more complex and difficult of application, and open to the criticism of inviting infection of the tissues because of their association with the mucous lining of the intestine. However, inasmuch as time is an important desideratum in intestinal sewing, the operator ought always to employ the suture with which he is most familiar, provided it meets the demands of proper repair.

**Intestinal Approximation.**—The approximation of the small intestines with each other and with the remaining hollow viscera of the digestive system in such a manner as to cause a change in the regular channel of transmission of the contents, is a procedure of modern practice. *End-to-end and lateral approximation* (intestinal anastomosis) are the common methods of intestinal operation. End-to-end approximation is done by means of common (Lembert and Halsted) and special suturing combined with invagination, as has been described already (Figs. 793 and 794). In addition to these methods others have been devised which are both prompt and effective, and the result of ingenious concep-

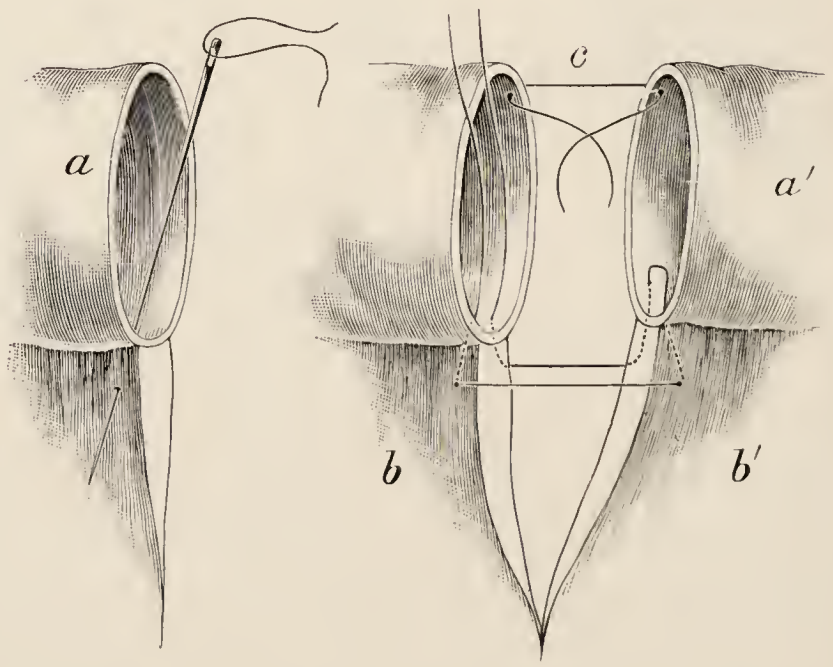



FIG. 799.—Maunsell's method, passing traction sutures.

tion and patient, laborious application. It is possible to describe in this limited space only those now in common use.

*Maunsell's Method.*—The ingenious method devised by Maunsell is entitled to much consideration. The technique of the method is substantially as follows: After carefully freeing the lumen of the bowel of its contents for some distance at either side of the proposed division, and compressing it to prevent return, the field of operation is protected by gauze pads, and the resection made. The parts are then thoroughly cleansed, the wound in the mesentery is closed, and the proximal and distal ends ($a, a'$) of the intestine are temporarily united with each other by two sutures, the extremities of which are left long. One of these sutures is so introduced from within ($a$) outward as to include the wall of the gut and the mesentery ($b$) at that side (Fig. 799), thence carried across to the opposite extremity ($b'$) and inserted upward and inward through the mesentery and bowel into the lumen, going across it downward and outward, piercing the tissues as before, finally passing through the mesentery and entering the bowel at a point adjacent to that of primary departure, leaving the free ends of the suture handily placed for subsequent grasping (Fig. 799). The second suture unites the borders of the intestinal ends opposite to the preceding one in a manner easily demonstrated by the cut.

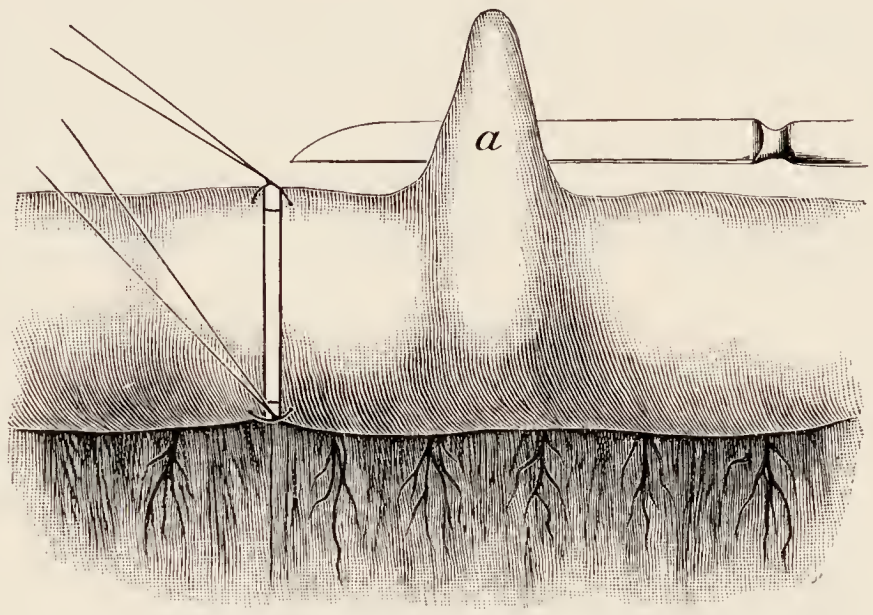



Fig. 800.—Maunsell's method, ends adjusted. Longitudinal slit being made ($a$).

Both sutures having been tied after a careful adjustment of the borders of the bowel (Fig. 800), a longitudinal slit an inch and a half in length is made through the free border of the larger extremity, about two inches from

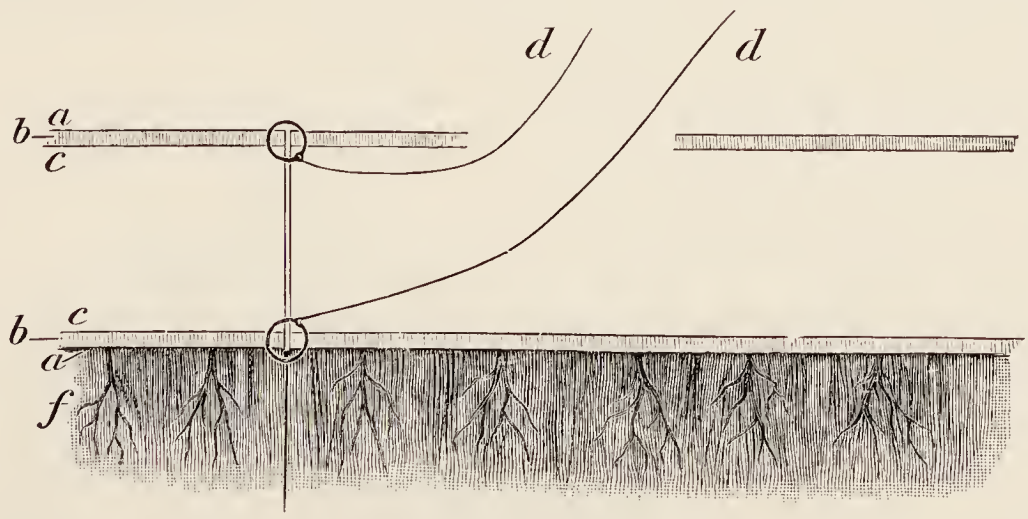



Fig. 801.—Maunsell's method, traction sutures ($d, d$) carried through longitudinal slit. $a, b, c$. Mucous, muscular, and serous coats. $f$. Mesentery.

the end, by means of a scalpel passed upward through a pinched-up portion (Fig. 800, $a$) of the intestinal wall at that situation. The ends of the trac-

tion sutures carried into the intestinal lumen and out through the slit by means of forceps (Fig. 801), are now pulled upon (*d*, *d*), thus causing the

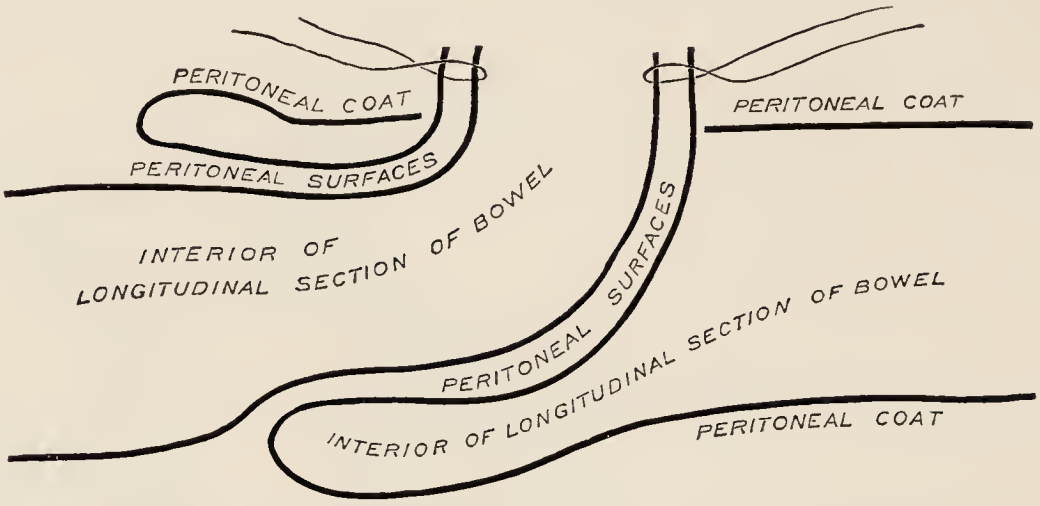



FIG. 802.—Maunsell's method, comparative relations of intestinal surfaces shown.

extremities of the intestinal segments to be dragged through the opening (Figs. 802 and 803) and to appear above as two concentric rings of intestinal tissue. While held in this position by the temporary sutures, the borders of the rings are transfixed through both walls with a cambric needle (*a*) armed with horsehair sutures. At each transfixion the suture is caught at the middle with forceps, drawn upward, divided and each half tied, thereby forming two independent sutures. About eighteen or twenty of these sutures—the result of nine or ten transfixions—are thus placed (Fig. 804). Finally, the temporary sutures are cut short, the invaginated ends by gentle traction are reduced, the longitudinal slit (*b*) is closed with Lembert sutures, and the operation is completed (Fig. 805).

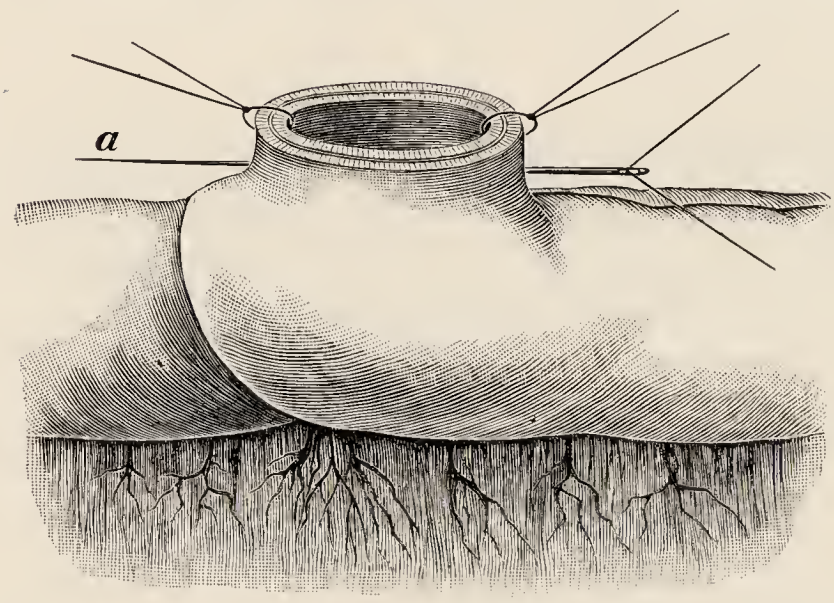



FIG. 803.—Maunsell's method, intestinal extremities drawn through the longitudinal slit; sewing began.

Segments of intestine of unequal size are readily united by this method in the following manner (Fig. 806): Unite the mesenteric borders with a temporary suture (*a*) as in the preceding instance; transfix the sides of the larger segment by a simple temporary suture (*b*) passed so as to include the superior border of the smaller segment, and tie it, leaving the ends long as

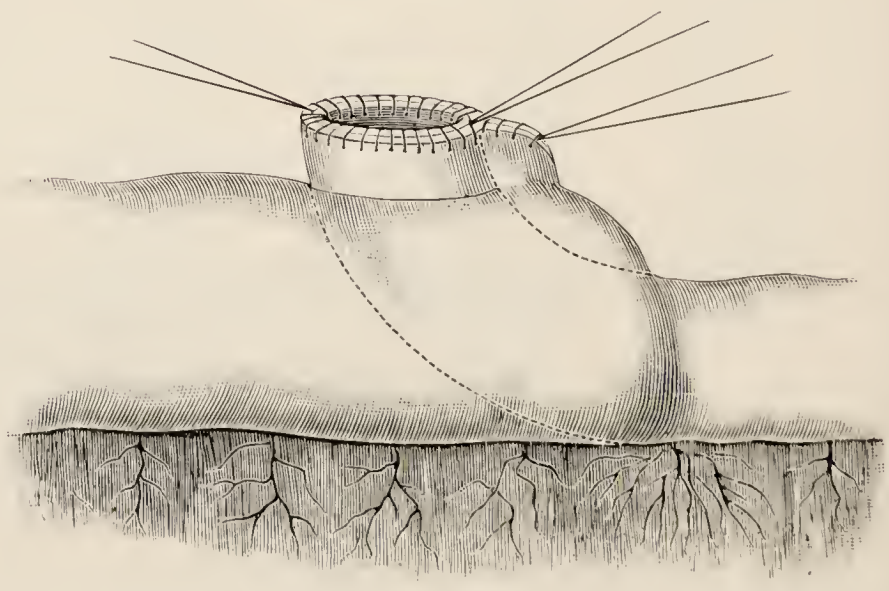


FIG. 804.—Maunsell's method, borders sewed.

before; pass a third suture (*c*) through the walls of the intestine at the highest point of the larger segment; make a longitudinal incision (*d*) at the superior border of the larger segment two inches from the end; pass the ends of the sutures through it, draw upon them so as to cause the ends of the segments to appear above the opening, where they are sewed in the manner already described, and illustrated (Figs. 802 and 803), after which the longitudinal slit (*b*) is closed with Lembert sutures (Fig. 807). If the difference in the diameters of the segments be great, it is better that a V-shaped portion be removed from the superior border of the larger one. After excision of a portion of the duodenum and of the pyloric end of the stomach (Fig. 808), the unequal

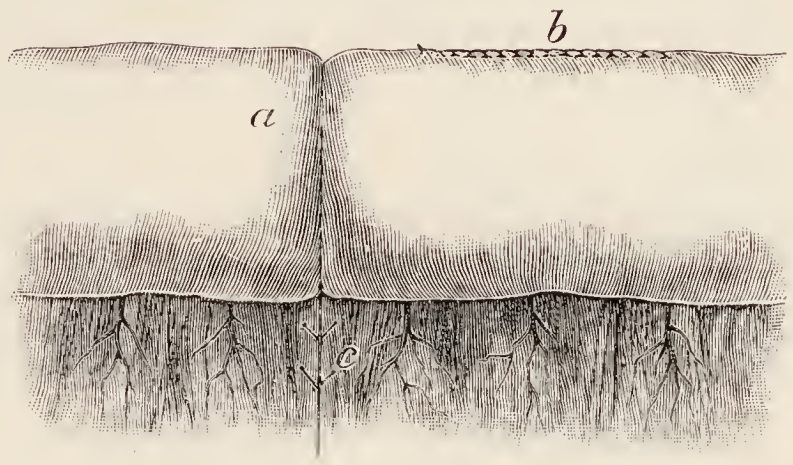



Fig. 805.—Maunsell's method, operation completed. *a*. Line of intestinal union. *b*. Slit closed. *c*. Mesentery sewed.

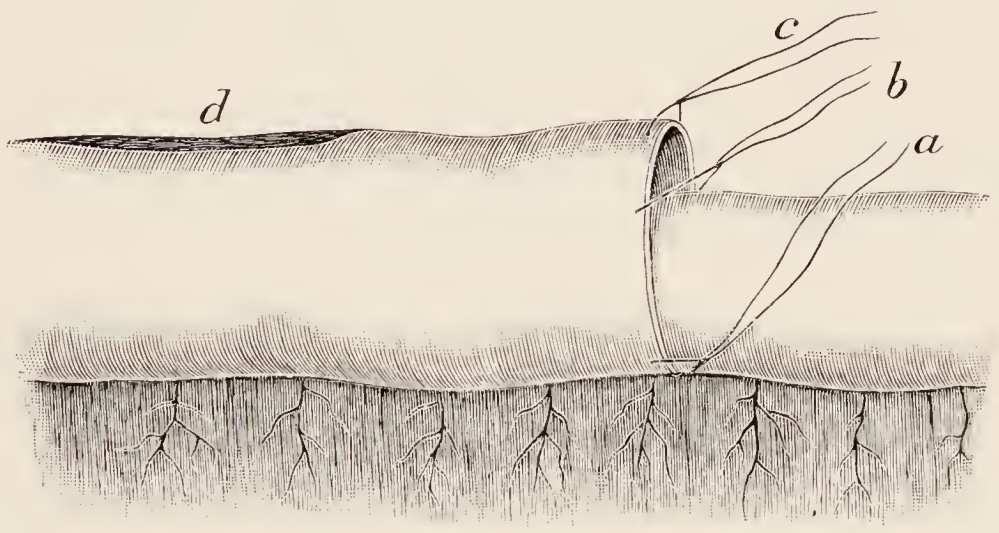



Fig. 806.—Maunsell's method, segments of unequal size.

extremities can be united with each other by first placing traction sutures in a manner similar to that in the anastomosis of unequal intestinal segments. The long ends of the traction sutures (*a*, *a*, *a*) are then passed into the stom-

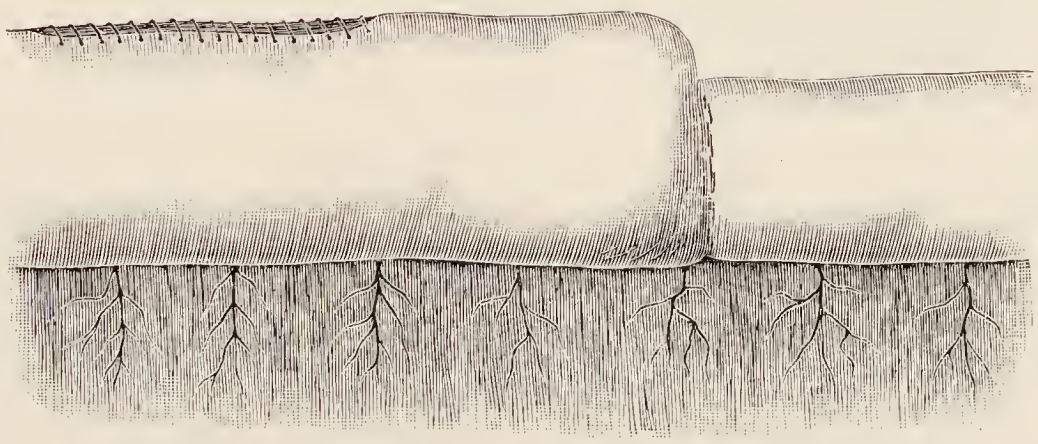


Fig. 807.—Maunsell's method, unequal segments, continuity restored.

ach and out through a slit made at its anterior surface (*b*), through which the divided borders are drawn by the sutures, and sewed, as for intestinal union. A movable part of the duodenum or the jejunum can be anastomosed with the

stomach by this method. A portion of the greater curvature of the stomach, along with the intestine in question, is exposed at the abdominal wound (Fig. 809), and the under surfaces are joined with two or three Lembert sutures. Corresponding openings are then made in the apposed surfaces of the viscera, and a traction suture is passed through the opening of each at the adjacent angles of the wounds (*b*), and the ends are introduced into the stomach and passed out through a long longitudinal slit (*a*) located at some distance above the point of junction, by means of which the divided borders are drawn upward and out of the superior incision and sewed, as in the foregoing instances. If the superior borders of the openings in the respective viscera be united with a few Lembert sutures, the upward displacement through the opening will be more readily and safely accomplished and the final sewing greatly facilitated. The preceding illustrations of the application of this method are an earnest of its utility in other portions of the intestinal tract to which its technique can be applied.

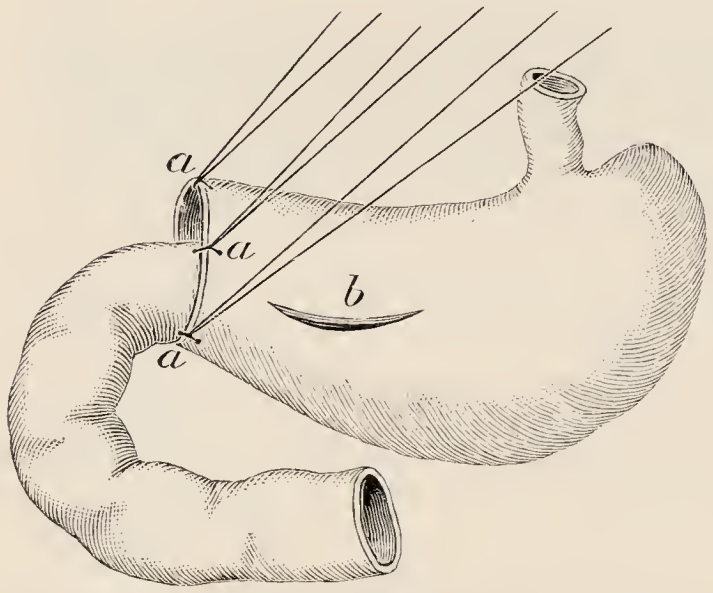



FIG. 808.—Pylorectomy, Maunsell's method.

*The Comments.*—The method of Maunsell is easily and rapidly employed, and is readily available, since its application needs the support of no special agents. However, it is open to the objections, first, of the possibility of inviting drainage infection of the peritonæum because of the through-and-through placing of the sutures, and, second, of liability to subsequent cicatricial contraction at the line of sewing caused by the ulceration processes incident to healing. The former objection can be met by a supplementary sewing of the serous surfaces along the line of their junction after the

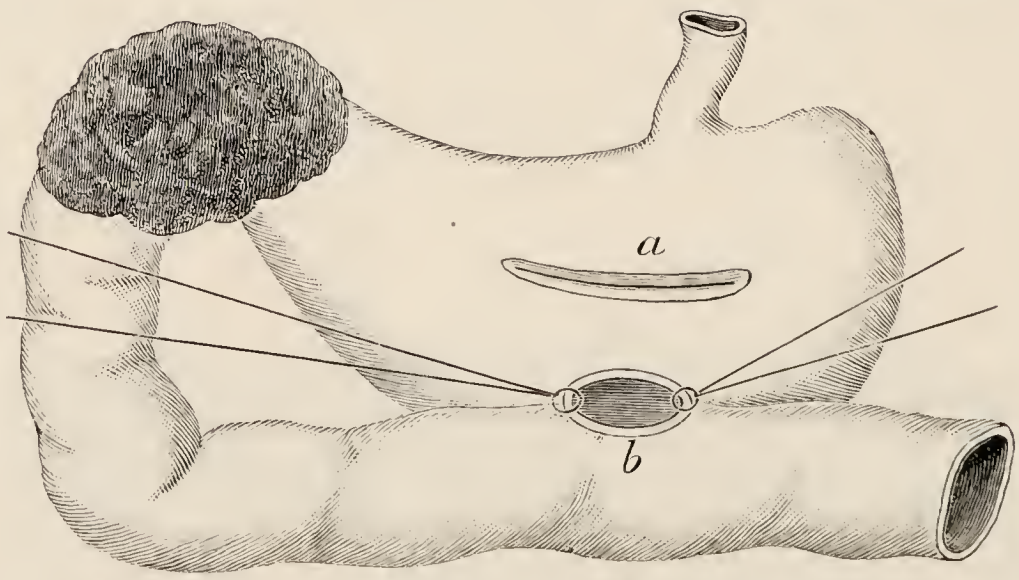



FIG. 809.—Gastro-enterostomy, Maunsell's method.

reduction of the invaginated borders. It is claimed (Wiggin) that the second objection has no practical foundation. It is better to ligature the mesenteric vessels that fall in the line of incision before their division than

after, for obvious reasons. The extremities of the divided intestines should be well supplied with blood to prevent their becoming gangrenous.

*Murphy's Button.*—Dr. J. B. Murphy has devised this singularly clever mechanism for the purpose of end-to-end and lateral approximation of hollow viscera (Fig. 810). The button is formed of two cups, one of which is known as the spring cup (*a*). Each is so constructed as to fit its fellow in a manner that secures perfect and continuous apposition of the serous surfaces of the open ends of the bowel, while at the same time the spring (*c*) exercises a gentle pressure on the intervening tissue, which is sooner or later severed by it, thus liberating the button in the intestinal canal. In addition to the button, intestinal clamps (Fig. 868) or other means of controlling the lumen of the intestine should be at hand; also a needle and silk sutures, and forceps for grasping the stem of the button.

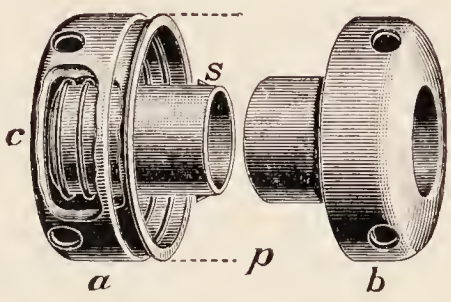



Fig. 810.—The Murphy button. *a*. Spring cup. *b*. Receiving cup. *c*. Wire spring regulating flange *p*. *s*. Stem with projecting springs.

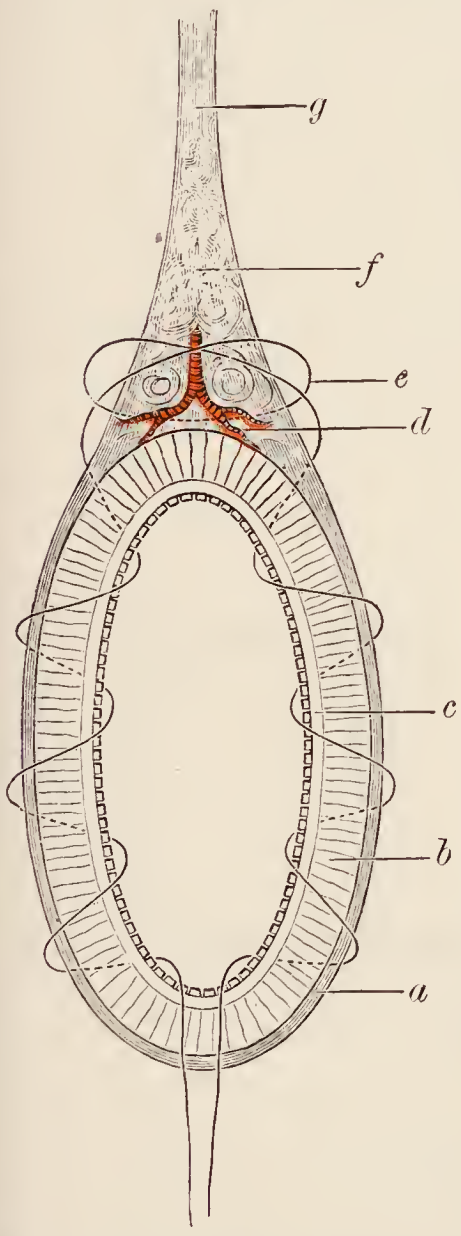



Fig. 811.—Section of small intestine and mesentery. *a*. Serous coat. *b*. Muscular coat. *c*. Submucous fibrous coat. *d*. Artery to bowel. *e*. Reverse overstitch and puckering string. *f*. Triangular space. *g*. Mesentery.

After the necessary cleansing and fortification of the contiguous parts against infection, and the control of the lumen of the gut is effected, a "puckering string" is placed around the free border of the end of the bowel (Fig. 811, *e*), commencing opposite to, and continuing on one side down to, the mesentery, which is grasped by a reverse overstitch (*e*), followed by a continuation of the topstitch up the opposite side to the point of beginning. It is noted that the ends of the suture are left long that they may be readily grasped. One cup of the button is then seized at the stem with forceps (Fig. 812), and is carried into the open end of the intestine and held there, while the puckering string is drawn tightly and tied at the base of the stem.

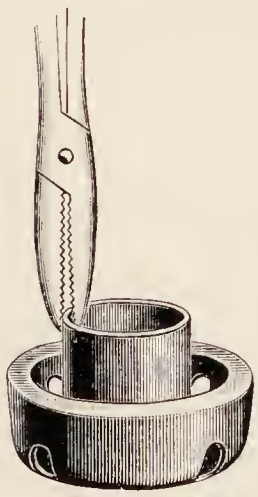


Fig. 812.

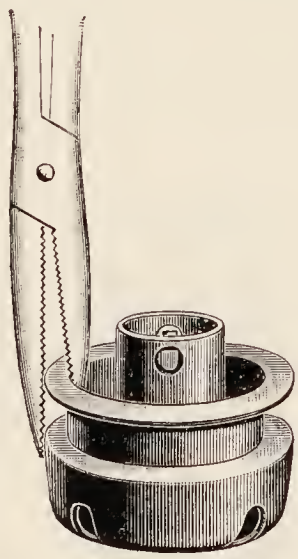


Fig. 813.

Fig. 812.—Cup seized for introduction.

Fig. 813.—Spring cup seized for introduction. Spring flange should be pushed down before grasping.

The remaining cup and end of the bowel are treated in a similar manner (Fig. 813), after which the cups are joined and pushed firmly together (Fig. 814). Extremities of unequal diameter can be united in a similar manner to that employed for those of a like caliber.

For the purpose of making a longer and perhaps more permanent opening between approximated viscera, Murphy devised an oblong button which does not differ in its mechanism and application from the round button in any essential respect (Fig. 815). This variety is commended by Murphy for use in lateral approximation of intestines with each other and in the performance of gastro-enterostomy.

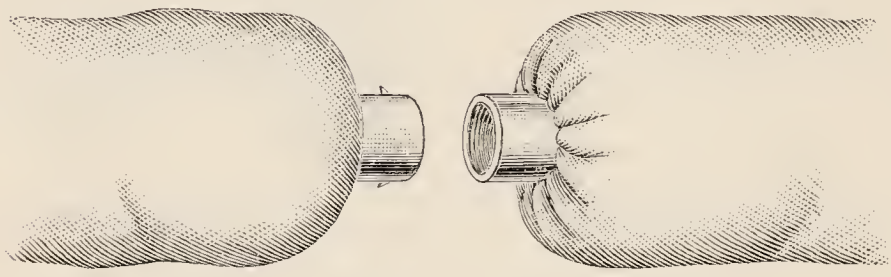


FIG. 814.—Parts prepared for joining.

*Lateral Approximation.*—Either the round or oblong button can be employed in lateral approximation. The use of the latter is followed by much the larger anastomotic opening, and for this reason, at least, may be regarded the better agent for the purpose. The puckering string in lateral approximation is placed in each instance opposite to the mesenteric attachment, as indicated in Fig. 816. A longitudinal slit is then made in the bowel of sufficient length to permit the entry of the form of button employed. As before, the parts of the button are grasped separately with forceps, introduced into the respective openings, raised outward, the strings drawn firmly and tied at the base of the stems. After which the parts of the button are united and firmly pressed together.

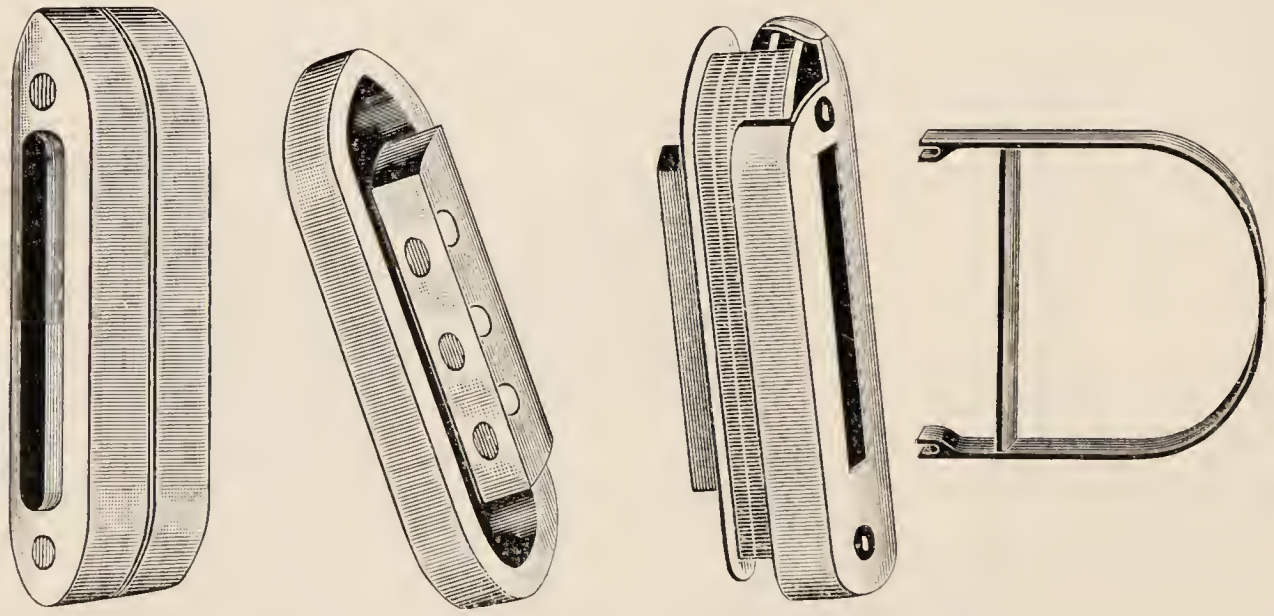


FIG. 815.—Murphy's oblong button and key.

*The Precautions.*—The ends of the puckering strings should be cut short, so that they will not be grasped by the closure of the button, and thus delay its escape. The button should fit the intestine loosely, otherwise the pressure of the rim will cause sloughing and perforation. The intestinal contents should be kept in a fluid state, to prevent the plugging of the openings in the button. If the gravity of the agent be sufficient to cause kinking of

the intestine and a proper adjustment of the relations be impracticable, another means of union should be substituted.

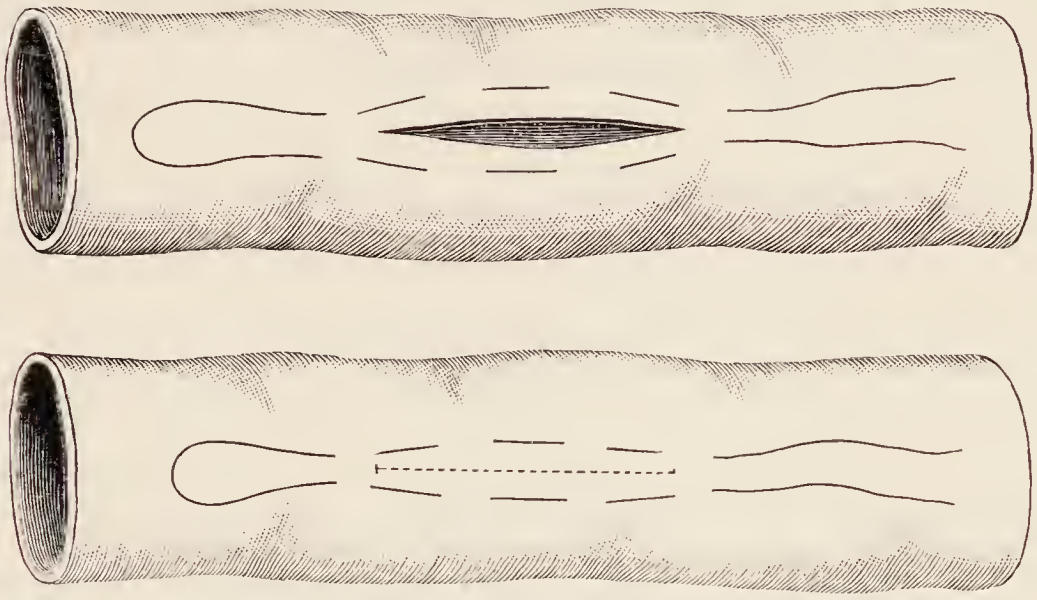


FIG. 816.—Lateral approximation with Murphy's button. Purse-string sutures placed and an opening made.

*The Comments.*—The use of the Murphy button is open to the rational objection that it introduces into the intestine a foreign body of considerable size, the effect and final escape of which are somewhat problematical. However, the rapidity and ease with which it can be employed, as compared with the longer time, greater difficulty, and absence of general knowledge and experience in the more complicated methods of practice, together with the success attending its use, have established for it a definite and commendable station in intestinal surgery. The oblong button is employed less frequently in lateral anastomosis than are other methods of approximation. In the three instances in which this form was used by the writer, the outcome was satisfactory in all respects.

*The Laplace Intestinal Approximation Forceps.*—The instrument consists of two symmetrically shaped compression forceps, with semi-elliptical blades, placed in juxtaposition with the concavities of the blades turned toward each other and locked together with a clamp (Fig. 817). The clamp grasps the two forceps at their joints, and is secured on either side by a pivot placed on a line with the axis of the joints, so that, all movements taking place around a common axis, both forceps can be opened and shut simultaneously to an equal extent. When both forceps are locked and their handles

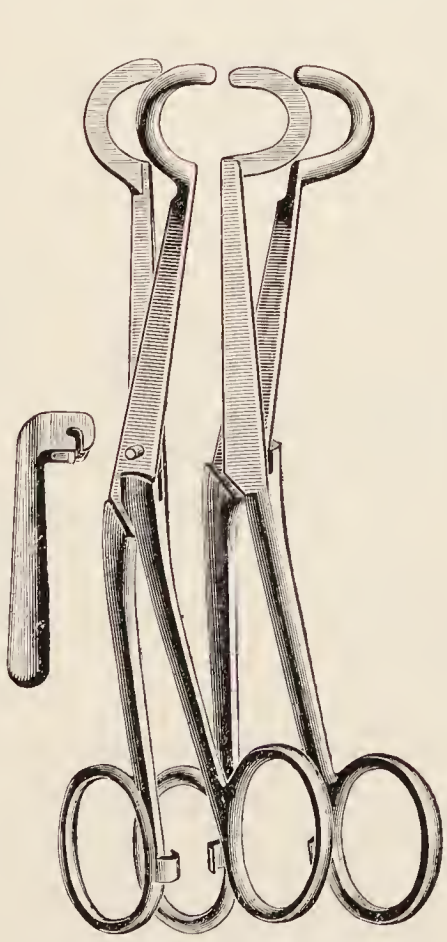


FIG. 817.—The Laplace forceps unlocked.

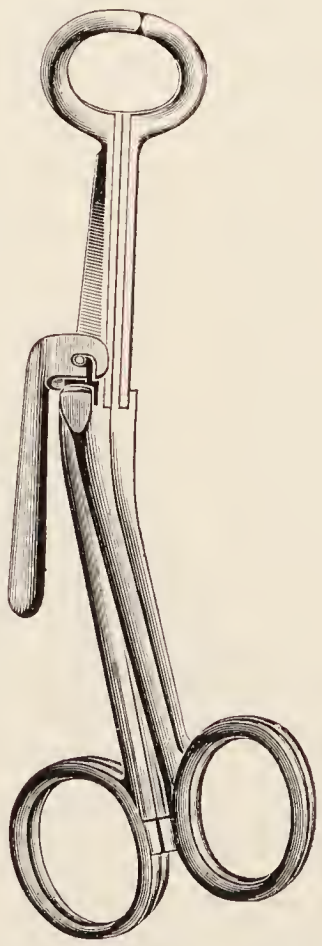


FIG. 818.—The Laplace forceps locked.

parallel, the closed, semielliptical blades of each side are brought opposite to each other so as to form one complete ellipse (Fig. 818). If now both forceps be opened simultaneously to an equal extent, the primary ellipse is divided into two by the separation of the blades.

*The manipulation of the instrument* consists, first, in opening it so as to cause an even separation of the rings and in inserting one of the rings within each lumen of the segments to be joined, thereby bringing the blades in direct contact with mucous surfaces internally, while the serous coverings remain external and overlie the compressing surfaces of the rings. The latter are then compressed together, whereby the included serous surfaces are brought in contact and the coats held firmly in apposition while the sutures are inserted. Serous surfaces are brought into contact throughout the entire circle of compression, with the exception of the site of exit of the handles of the instrument from the seat of operation where mucous membrane lines the opening. This latter is of advantage rather than otherwise, for on withdrawal of the instrument—which is done by unclasping the locks and removing each lateral half separately—the blades of each half in their exit sweep over mucous membrane only and come in contact with no serous surface. There are five different sizes of instrument to suit the various operations of anastomosis, including one for cholecystenterostomy, and another very small instrument used for the anastomosis of the ureter with the intestine, which is done by the lateral method.

*End-to-End Approximation.*—In end-to-end approximation the ends of the intestine are first tacked together with four equidistant traction sutures passing through all the coats. One, placed at the site of junction of the



Fig. 819.—End-to-end approximation, traction sutures in place.

mesenteric borders, is inserted with special care to include both layers of each mesentery, so as to close the triangular space of each segment which exists between the layers of the peritonæum at this situation; another is inserted at a point of the intestine opposite to this one; of the remaining two one is inserted at either side, midway between the first and second sutures (Fig. 819). The approximation forceps is now introduced, with blades closed, into one of the spaces between the sutures, excepting, how-

ever, those spaces next to the suture joining the mesenteric borders. The blades are then opened, and the rings, as they separate, are made to pass one into either intestinal extremity. If the edges of the gut tend to evert instead of falling between the rings, they can readily be drawn into place by a single turn of a thread passed around the line of the sutures between the blades. The instrument is then clamped, and in so doing the entire serous surfaces around the openings are accurately brought together for sewing, excepting at those extremities of the slits in which the blades rest (Figs. 820 and 821). The thread is withdrawn just before the blades are clamped. The further technique is the same as in end-to-end approximative anastomosis.

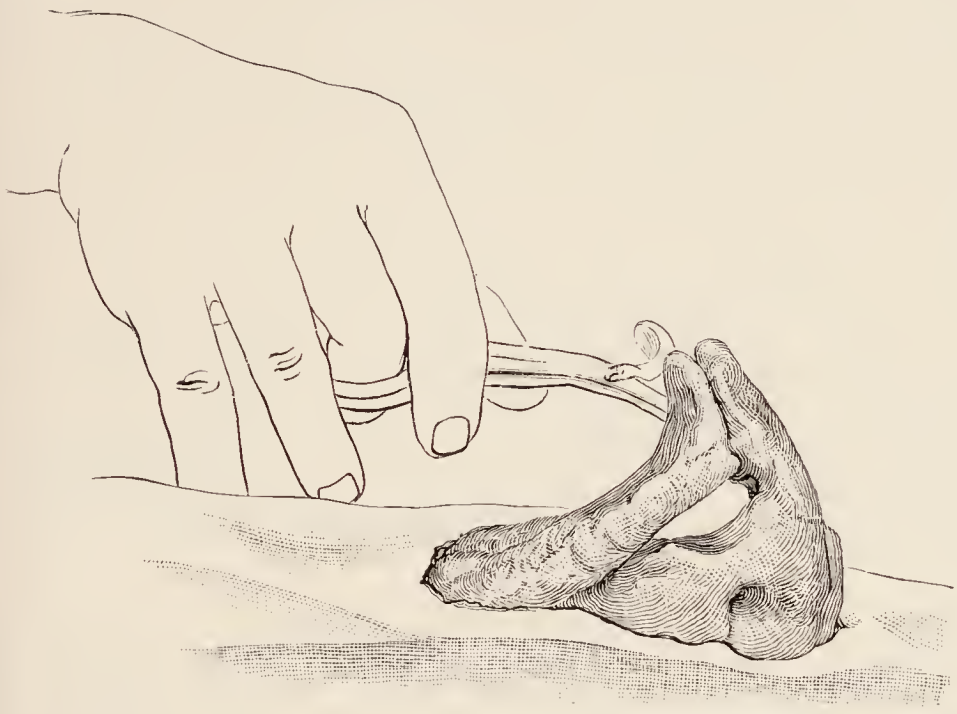


Fig. 820.—End-to-end approximation, forceps in place.

*The Comments.*—If before clamping it be found that the slits have been made a little too long to be included within the grasp of the blades, they can be shortened by a little lateral traction on the openings, making them a diamond shape, and thus approximating their extremities. The external portion of the adjusted instrument now acts as a handle to hold the seat of operation in proper position, which is of particular value in such operations as cholecystenterostomy and von Hacker's operation for gastro-enterostomy, where the surfaces to be sewed are difficult of approximation.

When the sutures have been placed for one half the circumference of the rings, by a half turn of the instrument—and, if a continuous suture be used, at the same time passing the needle behind the seat of operation—the remaining half of the circle is brought conveniently into place for the completion of the sewing.

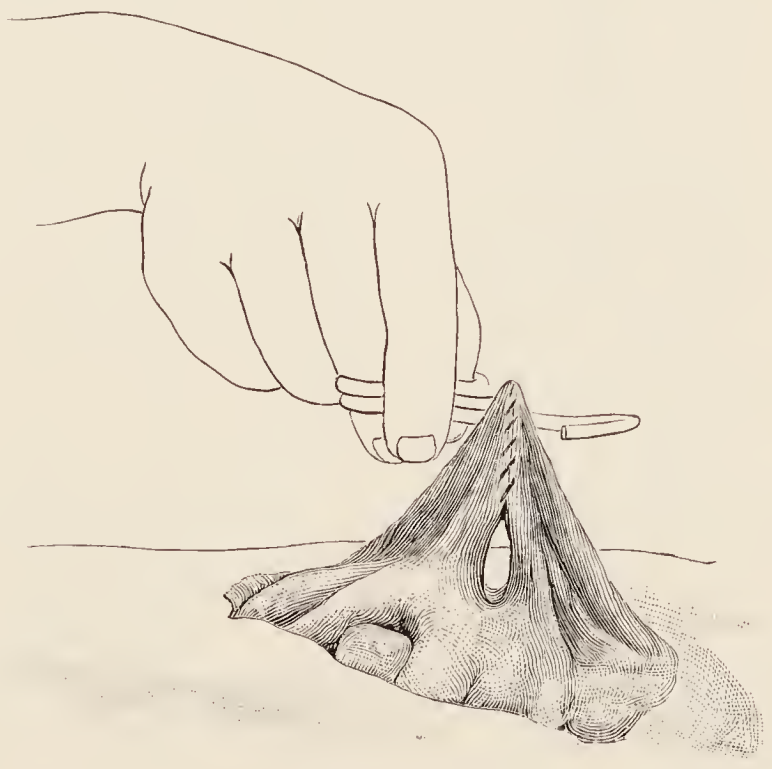


Fig. 821.—End-to-end approximation, sutures placed.

In the withdrawal of the blades from within the intestine, each forceps, after unlocking, must be first pulled directly outward until the elbow at the junction of the straight with the curved portions of the blades is well clear of the intestine

before the handles are swung around to finally extricate the semi-ellipse. The operation is completed by the inversion of the pouting mucous membrane at the opening which remains, and the closure of the latter with sutures.

*Lateral Approximation.*—In lateral approximation slits are made in the two hollow viscera to be joined, each a little longer than the transverse diameter of the elliptical rings of the instrument, so as to just admit of the easy entrance of the rings through the openings. The anastomosis forceps is opened and one metal ellipse is inserted into one of the slits and the other ellipse into the other slit, both passing entirely within the interiors of the respective viscera. Slight traction is then made on the handles of the instrument to draw the straight portions of the blades, which are just above the rings, snugly into corresponding extremities of the slits, which traction makes the latter assume a position in line with the short diameters of the ellipses and become parallel.

*The Invagination Forceps.*—This instrument is a long and narrow straight forceps, devised by Laplace (Fig. 822), by means of which the free end of a divided intestine is grasped close to its peripheral margin and the included tissues invaginated deeply within the gut, after which the serous borders are sewed over the invaginated portion. The instrument is left *in situ* as long as possible during the sewing, and when finally withdrawn the site of its exit is likewise closed by suturing.

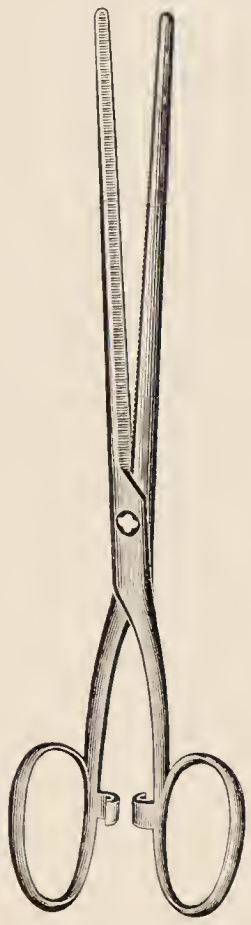


FIG. 822.—The Laplace invagination forceps.

Dr. Laplace states the advantages of the anastomosis forceps as follows:

"First, rapidity and accuracy of suturing without leaving any foreign substance within the gut; second, an absolute control of the field of operation by means of the assistance of the handles of the forceps; third, the facility with which the forceps is applied, preventing the escape of intestinal contents during the operation."

*The Comments.*—In two anastomoses performed on dogs by Dr. Laplace there occurred a subsequent closure of the opening of communication between the viscera joined. It happened where a thin intestinal coil was joined to a thicker one, and the failure to establish a permanent communication was ascribed to the fact that the sutures were not made to pass deeply enough through the coats of the thicker segment to shut off the circulation from the tissues immediately around the opening in the same, so that, instead of a sloughing of the margin of the aperture, granulations sprang up from the raw edges and effected the closure of the opening.

While this apparatus is ingenious and permits of rapid execution, it is apparently open to the objection so common in other methods—subsequent closure of the intestine from unwelcome repair. The status of its usefulness in the human economy is not yet established.

**Bone Bobbins.**—Bone bobbins as agents of intestinal approximation are associated in idea with the devices of Senn and Murphy. They are regarded by many as simpler, safer, quite as promptly applied as the former, and less likely to be followed by stricture. *Landerer* commends potato bobbins.

*The Decalcified Bone Bobbin of Robson* (Fig. 823).—The manner of its application is easily comprehended and can be readily practiced. Two rows of

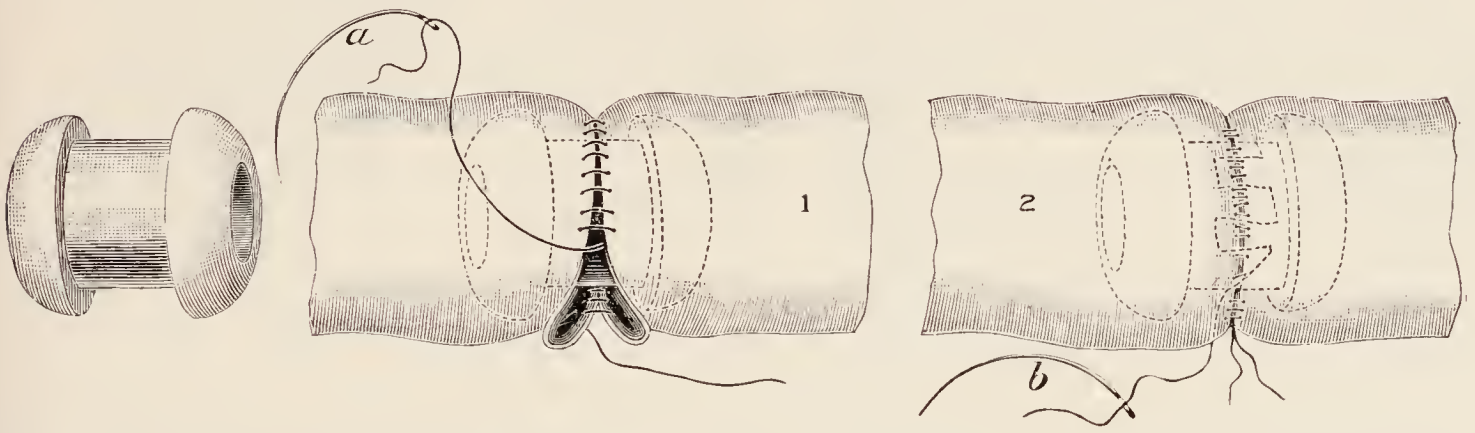



Fig. 823.—The bone bobbin of Robson. *a*. The continuous muco-mucous suture. *b*. The continuous sero-serous suture.

continuous sutures—an internal muco-mucous (*a*) and an external sero-serous (*b*)—are employed. Begin by introducing the external sutures at the farther half of the intestine, followed at once by the internal for the same distance. Put the bobbin in place and complete the internal muco-mucous suture, followed by completion of the external sero-serous suture. The continuous is employed for the internal suture. Either the Lembert or the Cushing variety may be applied externally. When great haste is essential a single row introduced deep enough to pierce the submucous fibrous coat will suffice.

*The Bone Bobbin of Allingham* (Fig. 824).—The center of this bobbin, and for a quarter of an inch at either side of it, is decalcified, and therefore is not influenced by suture pressure. The remaining portions are not decalcified. The shape of this bobbin tends to approximate the divided borders when closed around it, also opposes their slipping away. To apply it, carry a purse-string suture around each end of the intestine (*b*, *b*); insert one end of the bobbin into the extremity of a segment of intestine; draw the suture tightly around the bobbin, tying with a single knot at first; introduce the remaining end of the bobbin into the extremity of the remaining

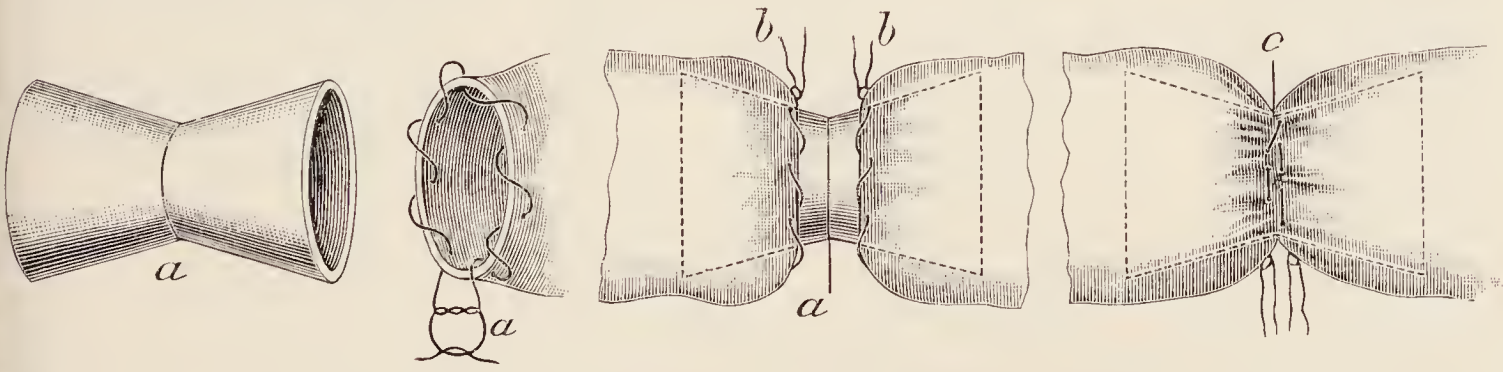



Fig. 824.—The bone bobbin of Allingham. *a*. Bone bobbin disconnected and in place.

segment and tie as before; push the ends firmly together at the center of the bobbin and tie an additional knot in each; supplement the line of union with continuous or interrupted sutures if needed (*c*). This method of prac-

tice seems insecure without the supplementary stitches. Little can be said as yet of the outcome of its practical application.

*The Bone Bobbin of Hayes* (Fig. 825).—The ingenuity of this bobbin entitles it at once to respectful consideration. The central part is not decal-

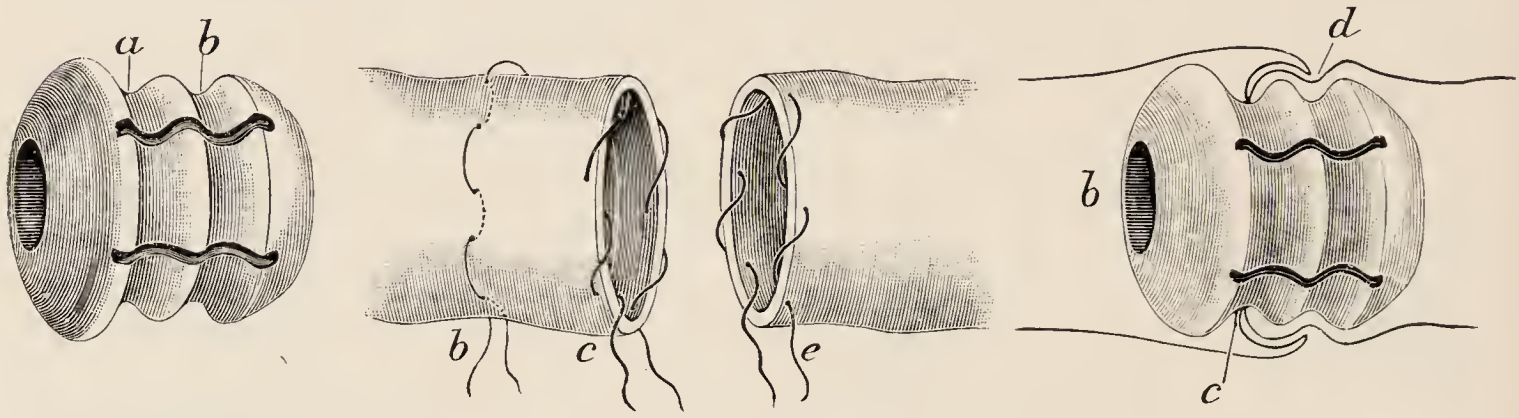



Fig. 825.—The bone bobbin of Hayes. *a*, *b*. Grooves in bone bobbin. *e*, *c*, *b*. Sutures. *c*. Distal groove. *d*. Proximal groove.

cified, and for the reasons relating to the preceding one. It has two grooves, proximal and distal (*a*, *b*), and is partly segmented. Three purse-string sutures are applied, two of which are placed similarly to those of the preceding method (*c*, *e*), the third being subserous (*b*), and well indicated in the illustration. The ends of the intestine are lodged securely in the proximal groove (*c*) by tightly tying the marginal sutures. The serous coat of the proximal segment of intestine is then drawn over the extremity of the distal and securely lodged in the distal groove (*b*) by means of the subserous suture (*b*), thus invaginating the end of the distal segment. Lateral approximation can be carried into effect by means of the button with but a single groove, in the manner well shown in the illustration (Fig. 826). Neuber's decalcified bone button (Fig. 827) is highly commendable.

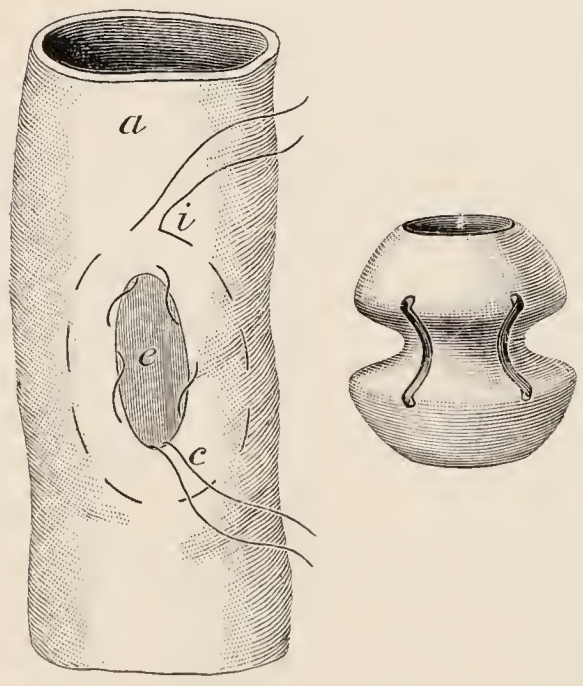



Fig. 826.—The bone bobbin of Hayes, lateral approximation. *e*, *f*. Apertures for bobbin. *d*, *c*. Marginal sutures. *k*, *i*. Subserous sutures.

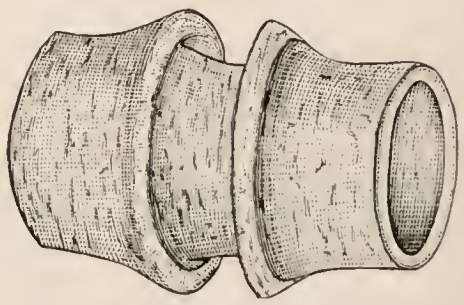


Fig. 827.—Neuber's tube of decalcified bone.

*The India-rubber Tube Method of Robinson.*—This method may be available when for good reasons other methods of practice can not be utilized (Fig. 828). Stitch, within the proximal segment, to the cut border a piece of rubber tube of suitable size, three or four inches in length, and scarify the serous surface for an inch from the extremity; dissect off the mucous mem-

brane from the distal segment for an inch with scissors, and curette the freshened surface to destroy the intestinal glands; push the proximal seg-

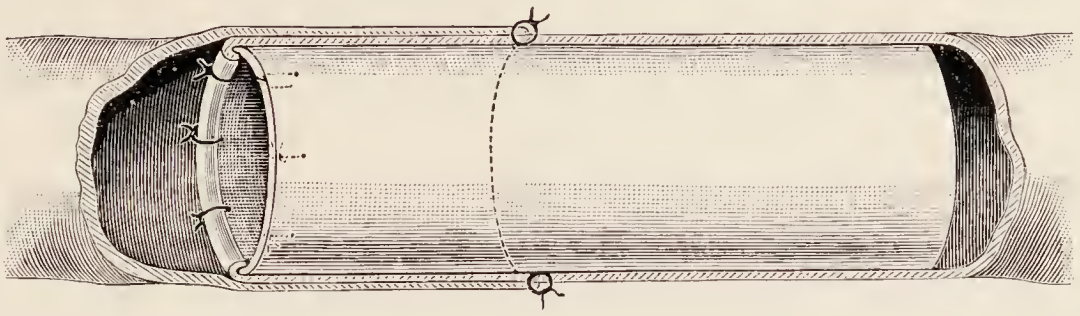


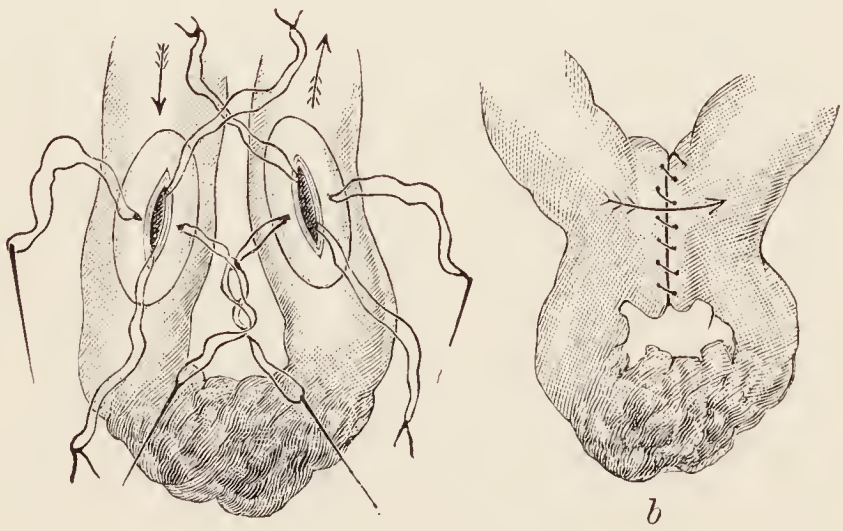
Fig. 828.—The India-rubber tube method of Robinson, longitudinal section.

ment into the distal and suture the serous margin of the distal to the corresponding serous surface of the proximal part, the stitches piercing the serous coat.

*The Remarks.*—The stitches connecting the tube with the gut should be tightly drawn to facilitate its separation. The decalcified bone cylinders of Jessert and Paul may be used instead. In these methods the calibers of the intestinal segments should correspond in size.

*End-to-end approximation of unequal segments* of intestine can be easily accomplished by Maunsell's method (see page 627), by the Murphy button without any reduction in the diameter of the larger segment, and by the removal of a longitudinally placed V-shaped portion from the larger end. In addition to these methods, *Wehr* advises that the end of the narrower bowel be divided obliquely at the expense of the convex border in such a manner as to cause the open extremity to conform in size with that of the larger intestinal segment (elbowing) (Fig. 867). In this instance two rows of sutures are employed, the same as in end-to-end sewing in other methods.

**Lateral Anastomosis.**—Lateral anastomosis is employed to establish a continuous communication between the intestine above and the intestine below a more or less permanent obstruction (Fig. 829). It is practiced instead of resection when the difficulty can not for a good reason be merely removed.



*a* *b*

Fig. 829.—Senn's method of performing lateral anastomosis. *a*. Plates in position within the intestine. *b*. After completion of the operation.

*The Method of Lateral Anastomosis of Senn.*—Senn's practice and advocacy of lateral intestinal anastomosis through the agency of decalcified bone plates brought both the method and utility of the operation into prominence. The plates are of three sizes, selected according to the age of the patient and the caliber of the viscus under consideration (Fig. 830). They are made of decalcified bone, are of oval shape, and provided with a central opening to correspond

with the proposed intercommunication between the united intestines. The bone plates are formed from sections of bone sawed from the femur or tibia of the ox, and decalcified by immersion in a ten-per-cent solution of hydrochloric acid, which is changed every twenty-four hours until they can be bent in any direction without fracture. They are then washed and placed for a short time in a weak caustic solution to remove the acid. Bone bobbins are prepared in a similar manner, but from sections of smaller bones. The bone plates are then fashioned so as to be a quarter of an inch in thickness, two and a half to three inches in length, and an inch in width, with a proper-sized opening made by cutting with a knife. The margins of the opening are provided with four silk sutures in the following manner: Thread each of two fine sewing needles with a fine aseptic silk thread twenty-four inches in length; tie the ends of the threads together and bring the needles to the middle (Fig. 831); draw a loop (Fig. 832) of the thread through each of the perforations and confine the loops in place by means of a thread passed through them and firmly tied (Fig. 833). *Stamm* simplified the arrangement of the sutures, introducing them into the plates in such a manner as to correspond with each other when tied, thus properly fixing them in position (Fig. 834). The plates are properly kept for use between two pieces of glass immersed in a solution made of equal parts of alcohol, glycerin, and water.

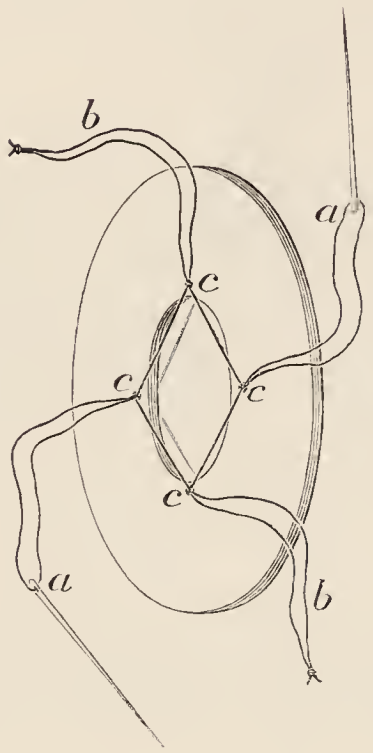



FIG. 830.—The decalcified bone plate of Senn. *a*, *a*. Fixation sutures. *b*, *b*. Approximation sutures. *c*,*c*,*c*,*c*. Openings in plate and anchor thread.

The plates are applied in the following manner: The loops of intestine to be joined are drawn out through the abdominal wound and carefully isolated with gauze, the contents of the bowel pushed aside and return is prevented by some form of intestinal clamp. An opening is then made in the long axis of one of the portions of bowel opposite the mesenteric border nearly equal in length to the long diameter of the perforation in the plate (Fig. 816). The plate is inserted into the bowel endwise, and the borders of the wound are properly adjusted to its surface by traction on the sutures, aided by manipulation with the fingers, after which the fixation sutures (*aa'*) are carried through the borders of the wound halfway between the angles by means of the needles. The remaining loop

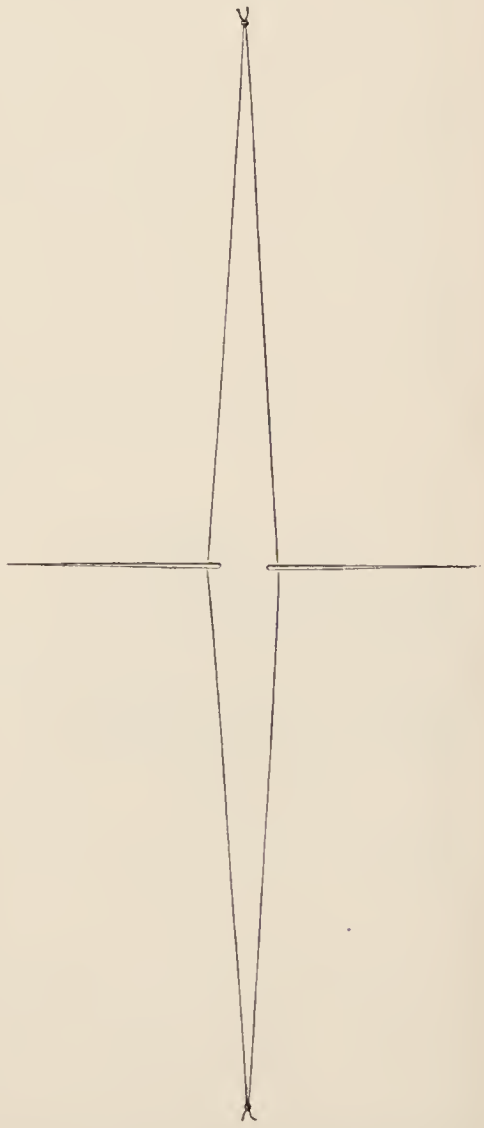


FIG. 831.—Silk threads tied, needles at the middle.

of intestine is treated in a similar manner. Several sero-muscular sutures are then inserted behind the plates (*c*) and the internal (*a'*) fixation sutures are tied (Fig. 835). The intestinal wounds are now brought into apposition and confined there by tying and cutting short the external fixation sutures (*aa*), then the apposition sutures (*bb*, *b'b'*) at either end. The operation is completed by carrying a continuous suture through the serous surfaces at the

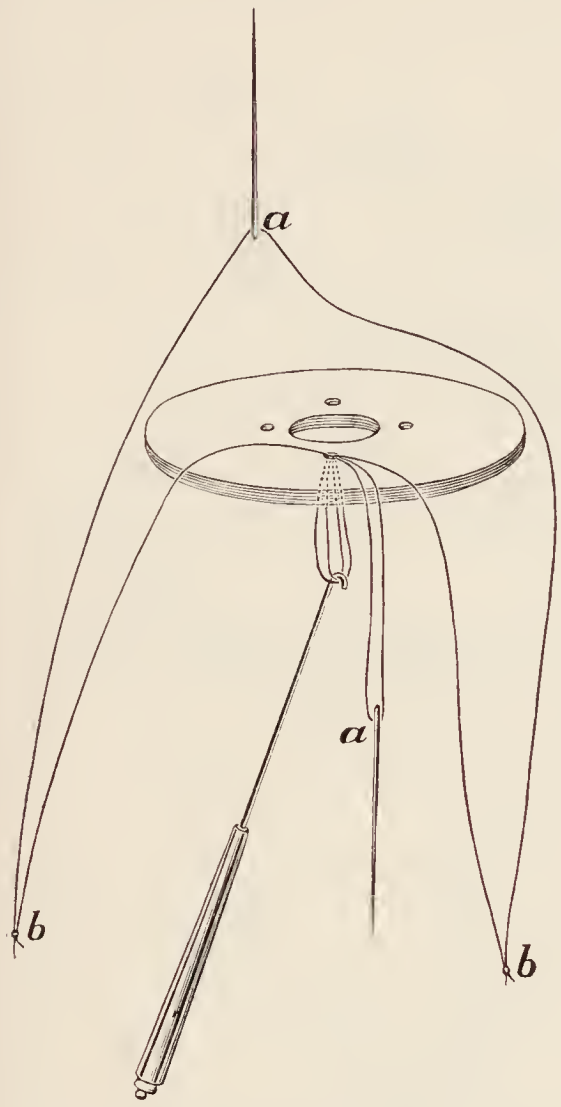



Fig. 832.—Threading Senn's plate. Passing first loop.

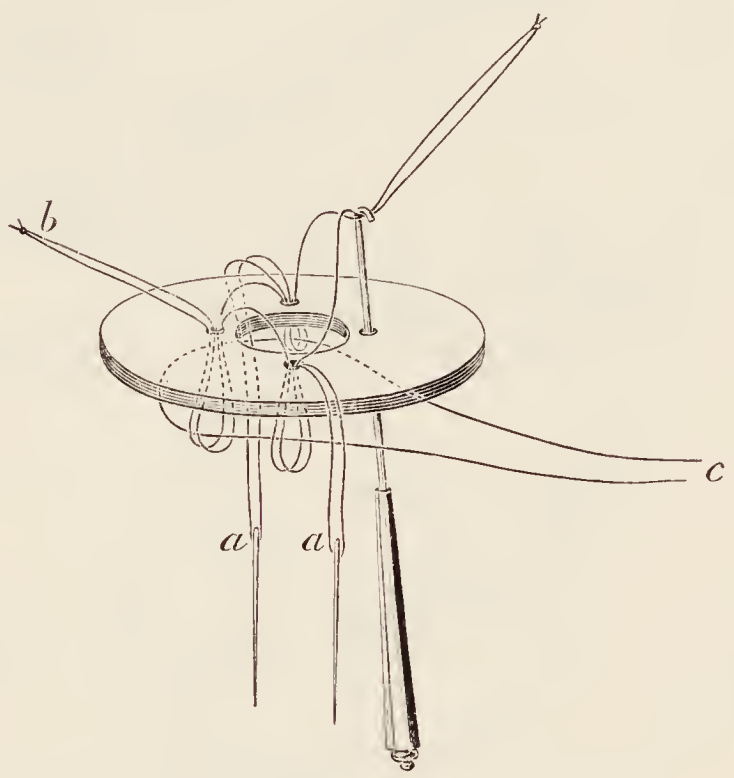



Fig. 833.—Threading Senn's plate. Passing last loop, anchor thread (*c*) passing through three loops.

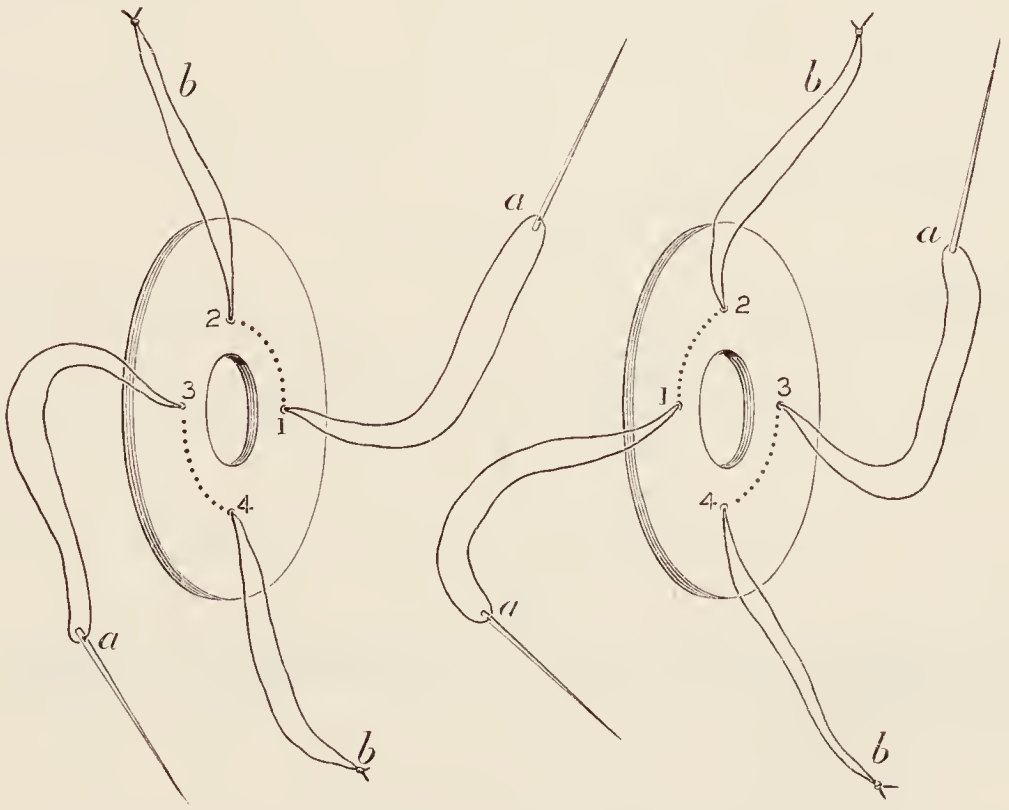



Fig. 834.—Stamm's arrangement of sutures.
*a*, *a*, *a*, *a*. Fixation sutures. *b*, *b*, *b*, *b*. Approximation sutures.

anterior borders of the approximation plates, thus fortifying the union and increasing the area of contact (Figs. 836, 837, and 838).

*The Precautions.*—Equal contact of the lips of the wound with the plates and exact apposition of the free borders should be carefully secured. Undue force in tying the plate sutures should be avoided, otherwise the resulting pressure may cause sloughing of the included tissues.

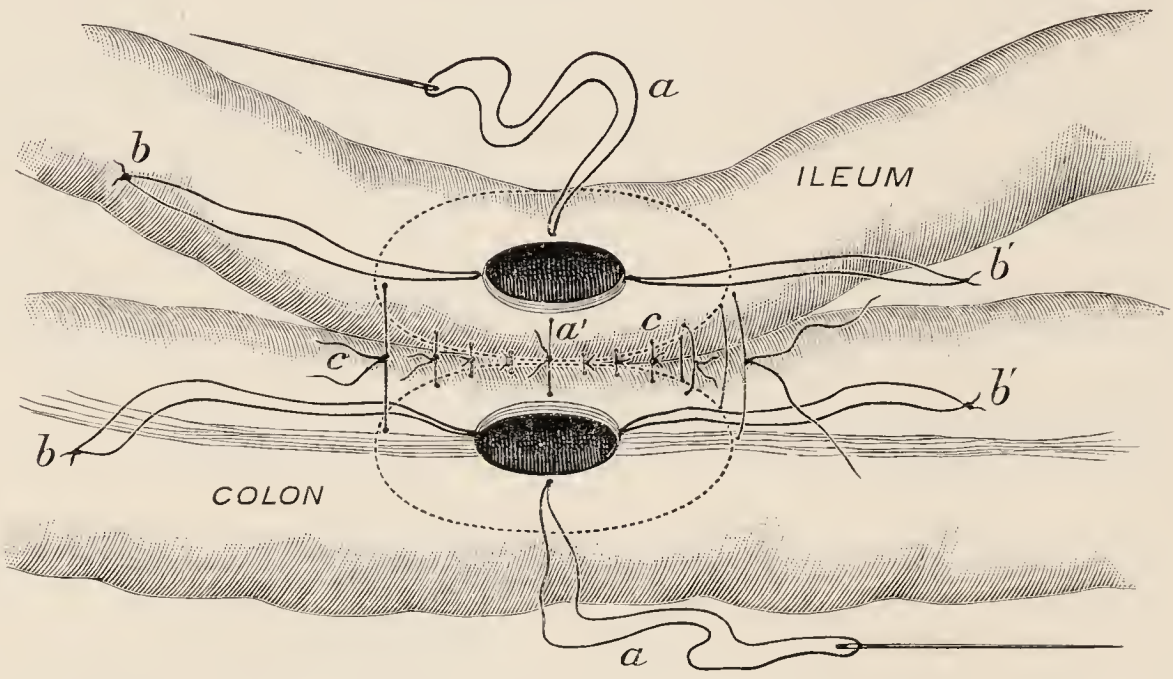



FIG. 835.—Lateral anastomosis, Senn's method. Plates introduced.

*The Remarks.*—Scarification of the serous surfaces included in the lips of the wound is sometimes practiced with the idea of hastening their union. However, there is but little reason to regard this step as essential. Supplementing the line of junction with omental grafts (Fig. 888) is advised by Senn in this as in other methods of procedure, especially if insecurity of union be suspected. The decalcified plates of Senn can be procured of those who deal in surgical supplies, and be kept at hand to meet the emergency calling for their use. Other plates of diverse nature are employed as sub-

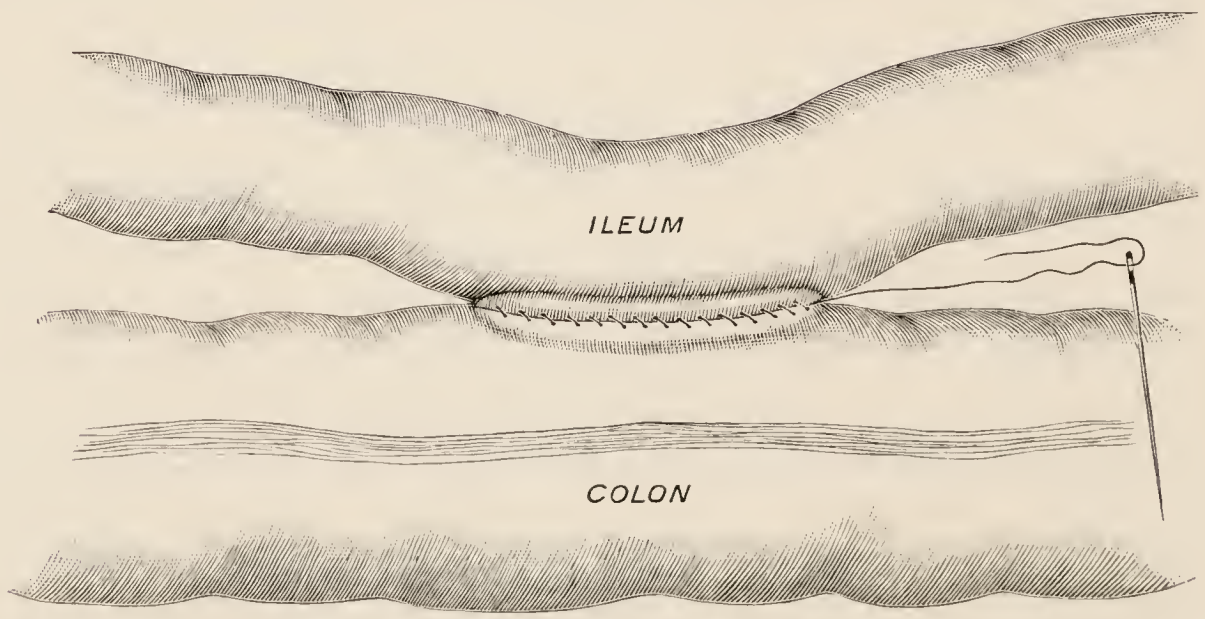



FIG. 836.—Lateral anastomosis, Senn's method. Plates approximated, sutures tied, continuous suture introduced.

stitutes. The catgut rings of Abbe, and similar rings and mats of Matas and Brokaw and others, while useful in an emergency, are less reliable than the plates of Senn. Cartilage plates made from the scapulæ of calves were employed by Stamm with good results. The turnip plates of Baracz and the

potato plates of Dawbarn are an earnest of ingenious forethought, for they can be promptly made, readily applied, and may therefore meet an otherwise unattainable need.

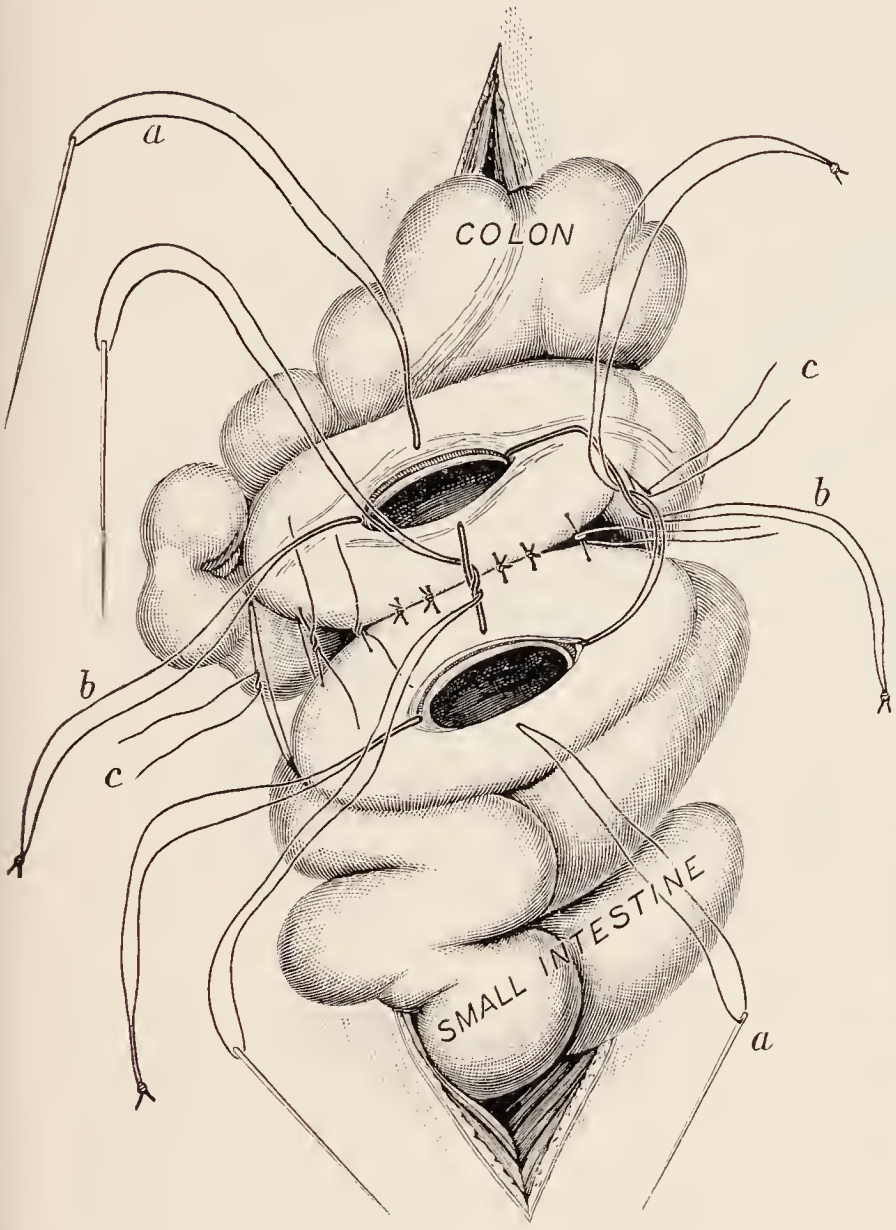



FIG. 837.—Lateral anastomosis, Senn's method. Posterior sutures introduced; innermost fixation, and right apposition sutures (*b*) looped for tying.

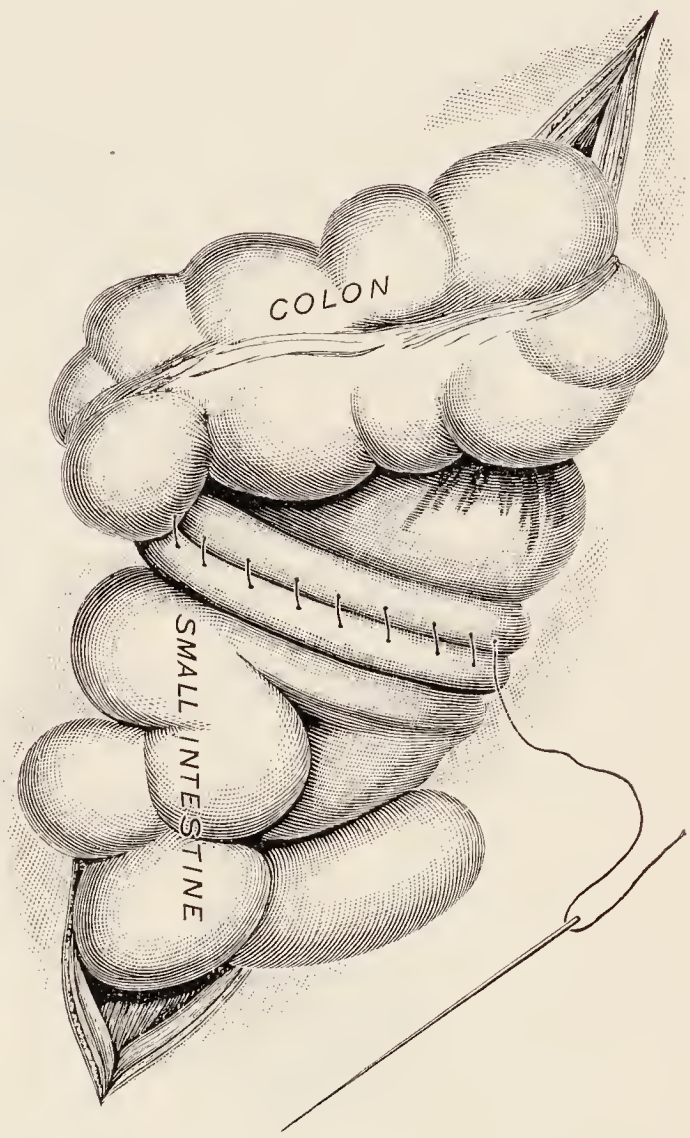



FIG. 838.—Intestinal anastomosis, Senn s method. Plates approximated and sutures tied; continuous suture completed.

*Lateral Anastomosis with Potato Plates* (Dawbarn).—The employment of potato plates for the purpose of intestinal anastomosis presents the surgeon with a material which is common and can be readily secured. These desiderata are indeed of great importance, since they afford the opportunity of quickly extemporizing an agent for an important purpose that might be otherwise unattainable (Fig. 839). The potato plates are made from large, firm, white or sweet potatoes, preferably the latter. They are cut one third of an inch in thickness, about five inches in length, and of a width that will permit them to slip easily into the bowel. After immersion in tepid water for an hour or two their density is much increased, causing them to assume a boardlike rigidity. A narrow slit, about four

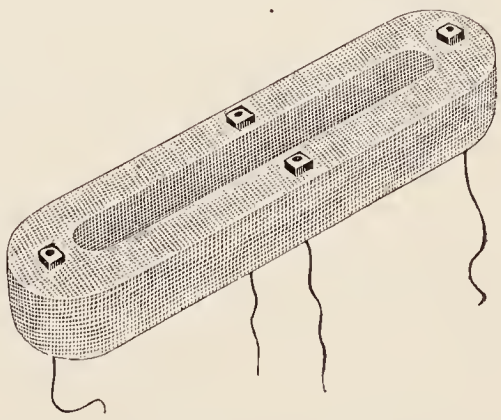


FIG. 839.—Lateral anastomosis, Dawbarn's method. Potato plate, ligatures in place.

inches in length, is then cut in the center of the long axis of each plate. Eight nine-inch coarse catgut ligatures, each armed with a firmly fitting round sewing needle and with large knots at the distal ends, are provided. A small retaining plate of rubber is then placed above each knot by passing the ligature through it. Through each plate at the proper distances four ligatures are passed and drawn into place and the ends of the needles are then buried in bits of potato, each about the size of a pea. Seize the distal needle with forceps, and pass it into the open end of the gut and upward about seven inches; remove the bit of potato and pierce the wall of the intestine at a point opposite to the mesenteric attachment (*a*); pass needles *b* and *c* in a similar manner; carefully adjust the plate by pushing, rather than drawing, into place with the ligature; pass the needle *d* and make the ligature taut, as also should be the preceding ones (Fig. 840).

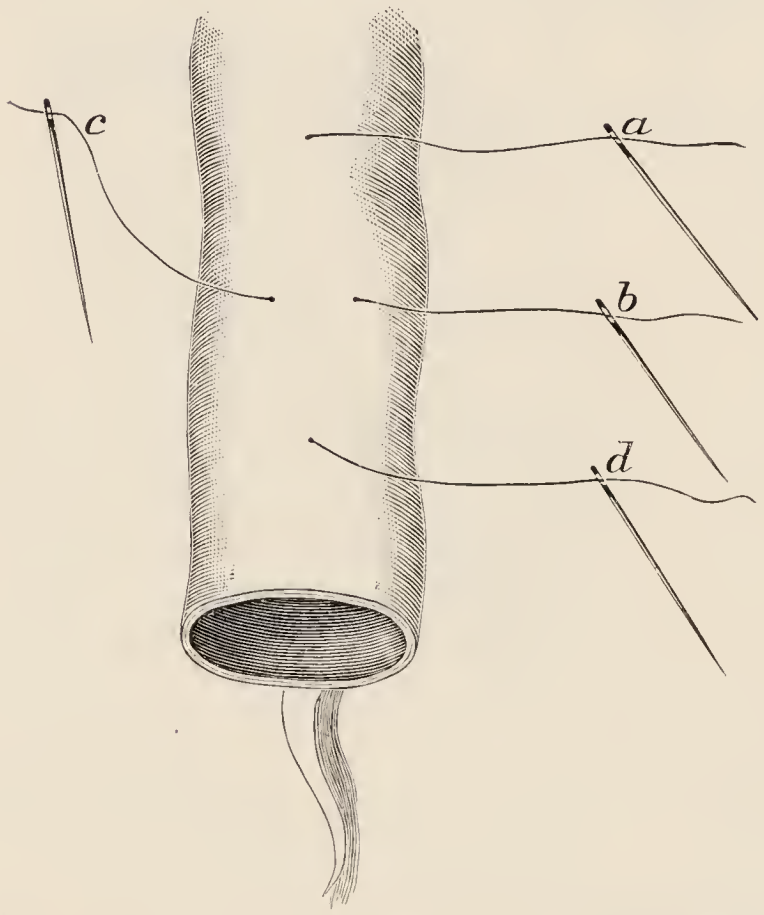



Fig. 840.—Lateral anastomosis, Dawbarn's method. Plate in position and ligatures passed.

The remaining plate and intestinal extremity are united in a similar manner. If short needles and ligatures are used instead of the long (Hall), the needles can be placed in position in the plate before its introduction into the bowel, and, after proper introduction, they are pushed upward entirely through the plate and intestine against a resisting body—strip of potato—applied without. The needles are then caught with forceps, the ligatures drawn through, and the plate is properly adjusted. Dawbarn regards this modification as important, since it greatly simplifies and hastens the procedure. The sutures are now cleansed with a cloth wet with antiseptic fluid, the serous surfaces lightly scraped with a scalpel to hasten union, and the corresponding sutures tied snugly, beginning with the undermost one, as in other methods. It is not material whether the open ends of the intestine point in the same or opposite directions before the plate sutures are tied. A Lembert suture should be placed without, opposite to each plate suture, for greater security. In fact, numerous sutures of this pattern, or a continuous one, may be introduced around the borders of the plate for a similar reason. A narrow, thin strip of wood is now introduced into the open end of one of the pieces of gut beneath the potato plate, and through the remaining open gut end the apposed intestinal walls are divided with a sharp-pointed bistoury or scissors in a line corresponding to the slit in the plates down upon the apposing surface of wood (Fig. 841). Arrest hæmorrhage by means of forceps passed through the open ends of the

intestine, irrigate the wound, thus cleansing it and testing the integrity of the sewing.

The open ends of the intestine are invaginated and closed by continuous or interrupted sutures. Dawbarn now advises the use of curved sweet-potato



Fig. 841.—Lateral anastomosis, Dawbarn's method. Parts approximated; strip of wood and the knife introduced to form the anastomatic opening.

plates, armed with a ligature at either end, instead of those just described (Fig. 842). Securer approximation when tied in place, longer duration as restraining agents, and greater dispatch of application are the chief claims of advantage for this variety. It should not be overlooked, however, that demands may happen where sweet potatoes are not available for use.

*The Remarks.*—The novelty of the proposition of the use of vegetable plates and the successful demonstration of their utility, together with the possible need for their employment, gives to them an important and definite position in the field of surgical endeavor. Four instances of use in the human subject of the potato plates, with three recoveries, is the extent of their practical record.

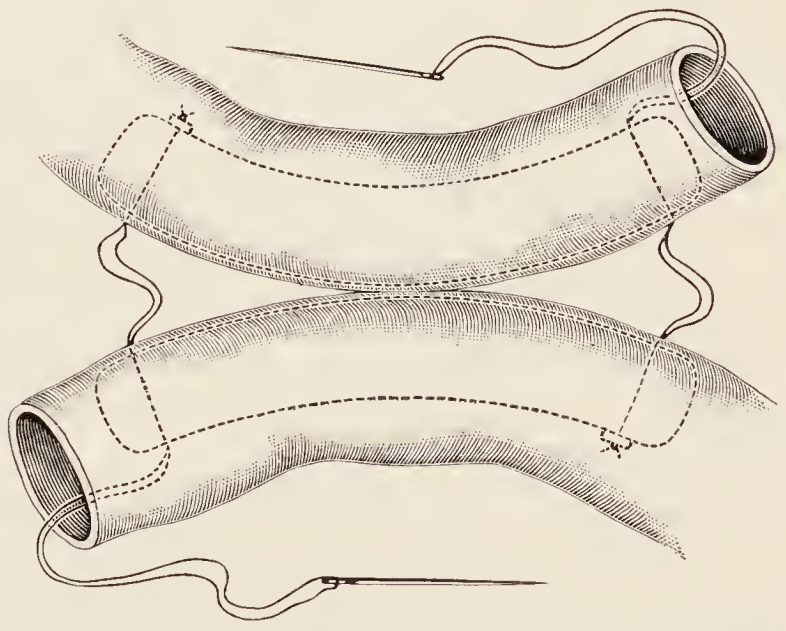


Fig. 842.—Lateral anastomosis, Dawbarn's amended method. Curved sweet potato plates in place.

*Lateral Anastomosis with Segmented Rubber Plates* (Robinson).—According to the designer, "take two pieces of rubber band, similar to those used in closing a purse or a bundle of papers, about two and a half inches long and three and a quarter inches wide. For larger openings the bands should be longer. Cut the corners

off, as shown in Figs. 843 and 844. In the center and at the side of each band to be approximated cut out a triangular piece, leaving, when the two halves are fastened together (*c*, *c*), a square aperture in the middle of the plate. Cut out two holes (*gg*, *gg*) at each side, half an inch apart. The holes are made large, so that the part of the chamois-skin ring, to be described, with the linen thread, will easily pass through. From a piece of chamois or sheepskin cut off several long strips, like wide shoestrings, and twist two or three of them together so as to form a ring. This ring (*d*) is fastened to the plate, as shown in Fig. 844, with catgut sutures (*c*). Finally, loop six linen sutures (*e*) (Barbour, No. 40), armed with milliners' needles, on the ring, and the plate is ready for use."

The openings into the viscera for the purpose of introduction of the plates should be three and a half to four inches in length. A plate is carried through the opening into the organ and the needles are caused to

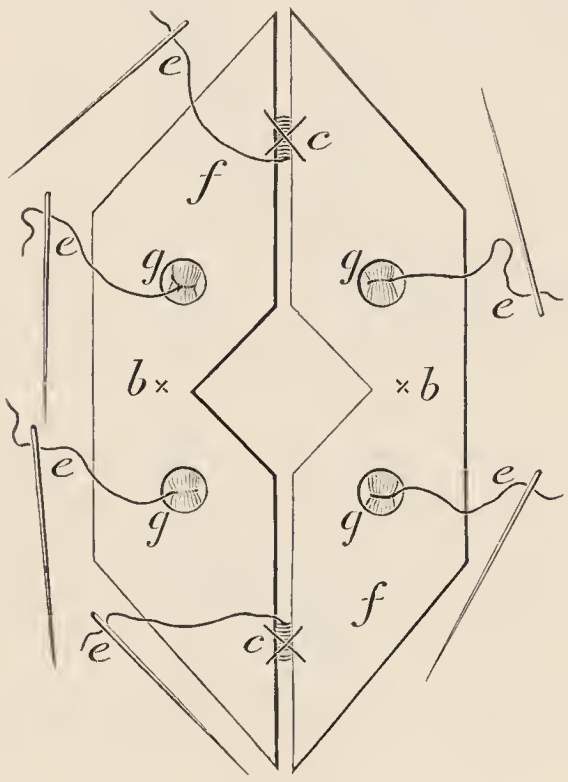



Fig. 843.

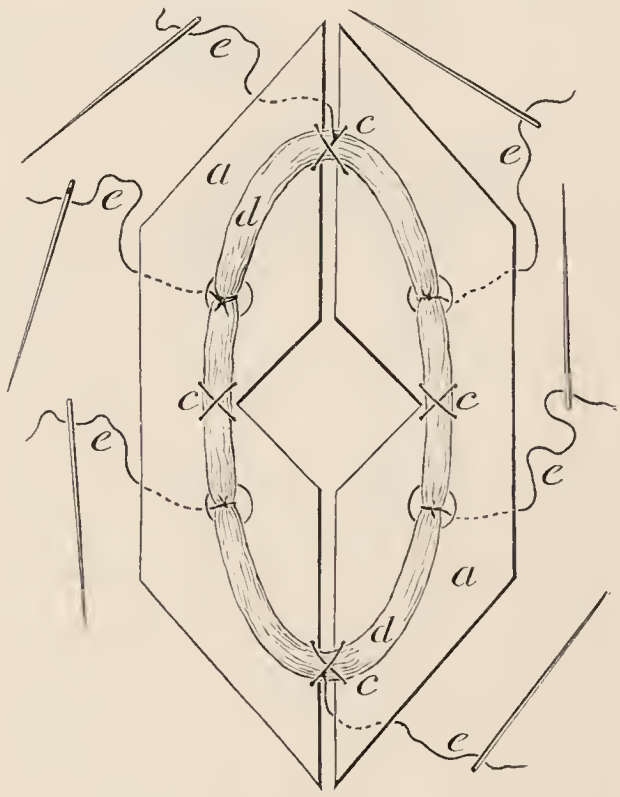



Fig. 844.

Fig. 843.—Lateral anastomosis, segmented rubber plates, Robinson's method. *f*. *f*. Face of plate. *c*, *c*. Stitches joining rubber segments at ends. *g*, *g*, *g*. *g*. Lateral holes in plate for sutures. *e*, *e*, *e*, *e*, *e*, *e*. Sutures tied to chamois rings, passing through holes armed with needles. *b*, *b*. Sides of segment stitched to chamois ring.

Fig. 844.—Lateral anastomosis, segmented rubber plates, Robinson's method. *a*, *a*. Back of plate. *d*, *d*. Chamois ring stitched to plate at *c*, *c*, *c*, *c*. *e*, *e*, *e*, *e*, *e*, *e*. Six sutures armed with needles, each fastened to chamois ring, one passing between the segments at either end of the plate.

traverse its walls, at a proper distance from the edge of the incision, from within outward.

The threads of the plates should correspond with each other when the latter are in proper position, so that when tied the plates and tissues will be properly adjusted. The sutures are cut short, and the union is reinforced by Lembert sutures placed at the borders.

**Lateral Anastomosis by Sewing Only.**—Abbe advocates strongly the abolition of all mechanical devices in intestinal anastomosis. He regards union by sewing as being the only safe and reliable measure. After excision of the intestine has been performed, invert the open ends of the

divided bowel, and close them with a double row of colored silk sutures; overlap the closed extremities of the bowel four inches or more, or reverse and place them end to end as is most convenient; unite the apposed surfaces by two parallel rows of continuous sutures, each four inches in length, placed a quarter of an inch apart, and introduced by means of cambric needles, each armed with a colored silk suture twenty-four inches in length, each suture

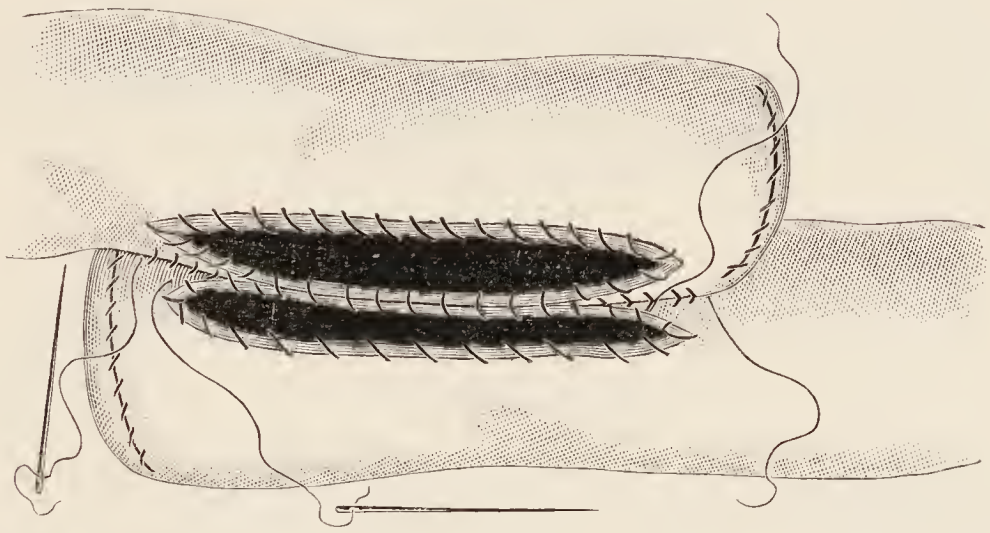


FIG. 845.—Lateral anastomosis, Abbe's method. Lower rows and whipstitch rows of sutures introduced.

being left at the end of its row still threaded (Fig. 845); make a longitudinal opening into the side of each extremity of intestine, about an eighth of an inch from the line of sewing, four inches in length; sew rapidly with over-hand stitch the borders of either opening with a third needle armed with a long colored silk suture, which unites together those margins already apposed; cleanse the parts and complete the union by the continuance of the first two rows of sutures around the opposite unsecured edges, thereby providing three rows of sutures for the lower and two for the upper line of union (Fig. 846).

*The Remarks.*—The primary rows of sutures should be made about an inch longer than the proposed opening into the intestine. The whipstitch, passed around the borders of the respective openings, secures the proper relations of the coat of the intestine at these places, and also arrests the bleeding.

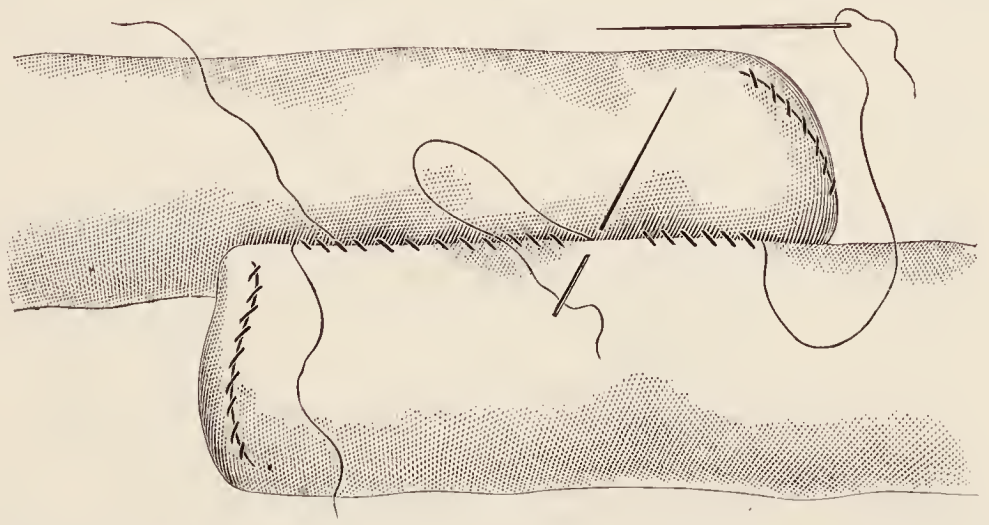


FIG. 846.—Lateral anastomosis, Abbe's method. Anterior rows of sutures applied.

Only nimble fingers, directed by much experience, can quickly and satisfactorily accomplish this form of union.

*Halsted's Method.*—Halsted's method of sewing differs from that of the preceding. He employs the mattress suture, and introduces but one row.

The portions to be anastomosed are placed side by side, and joined to each other by six or eight mattress sutures introduced opposite the attachments of the mesentery (Figs. 847 and 848) and tied. Two additional sutures

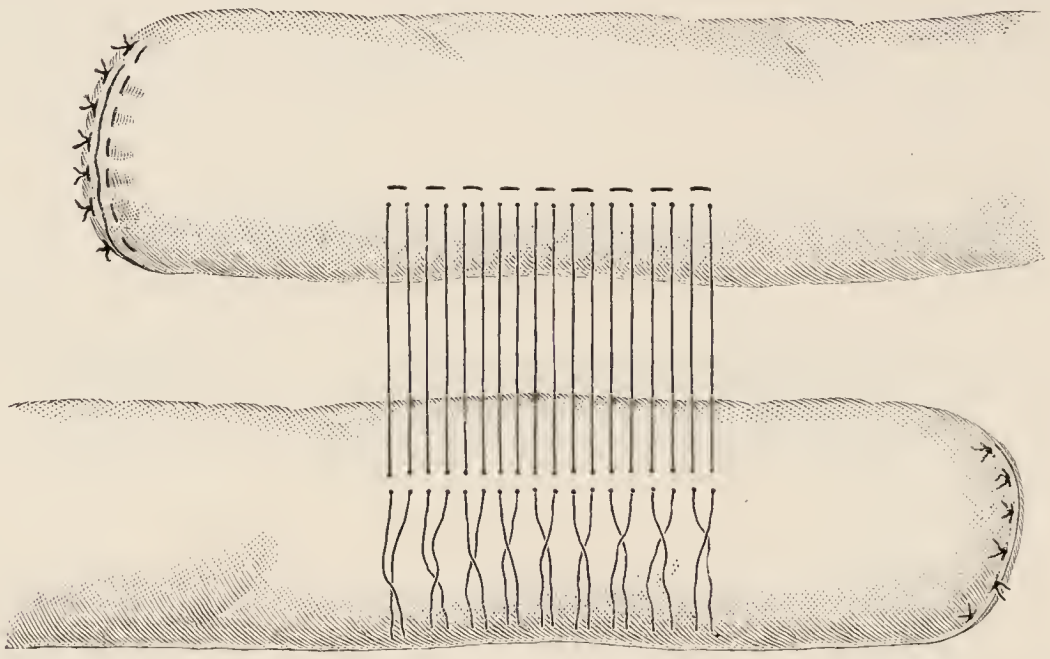


Fig. 847.—Lateral anastomosis, Halsted's method. Posterior mattress sutures introduced.

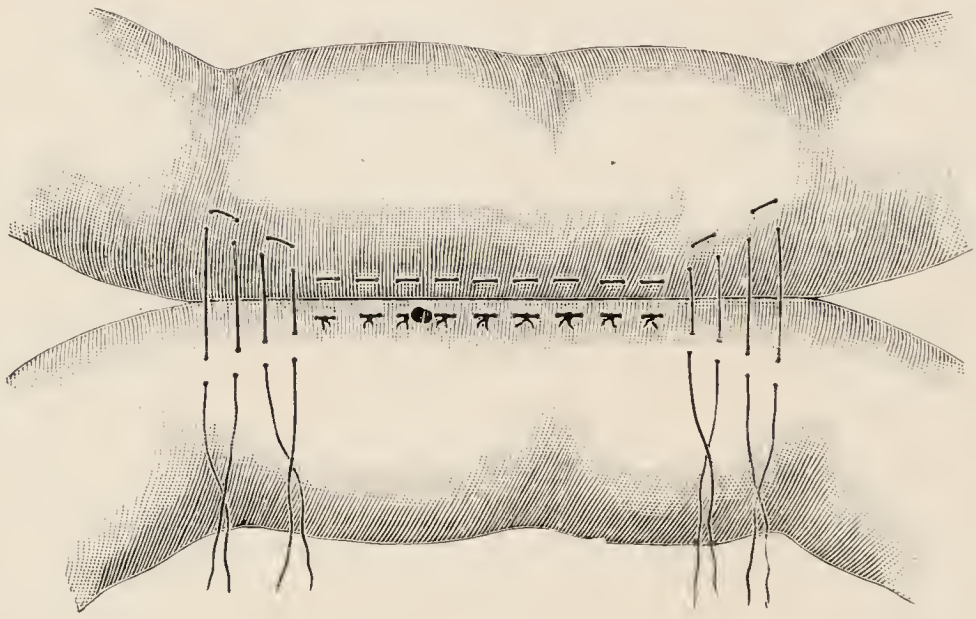


Fig. 848.—Lateral anastomosis, Halsted's method. Posterior sutures tied, incurvation sutures applied.



Fig. 849.—Lateral anastomosis, Halsted's method. All sutures tied, forward curving established.

are so introduced at either end of the preceding (Fig. 848) as to cause a forward curving of the line of approximation when tied (Fig. 849). The anterior row of sutures—ten or twelve in number—is now laid, but before tying

are drawn apart (Fig. 850), and an opening of proper size is made at either side of the primary sewing into the intestine. The sutures are then tied (Fig. 851) and the operation is completed.

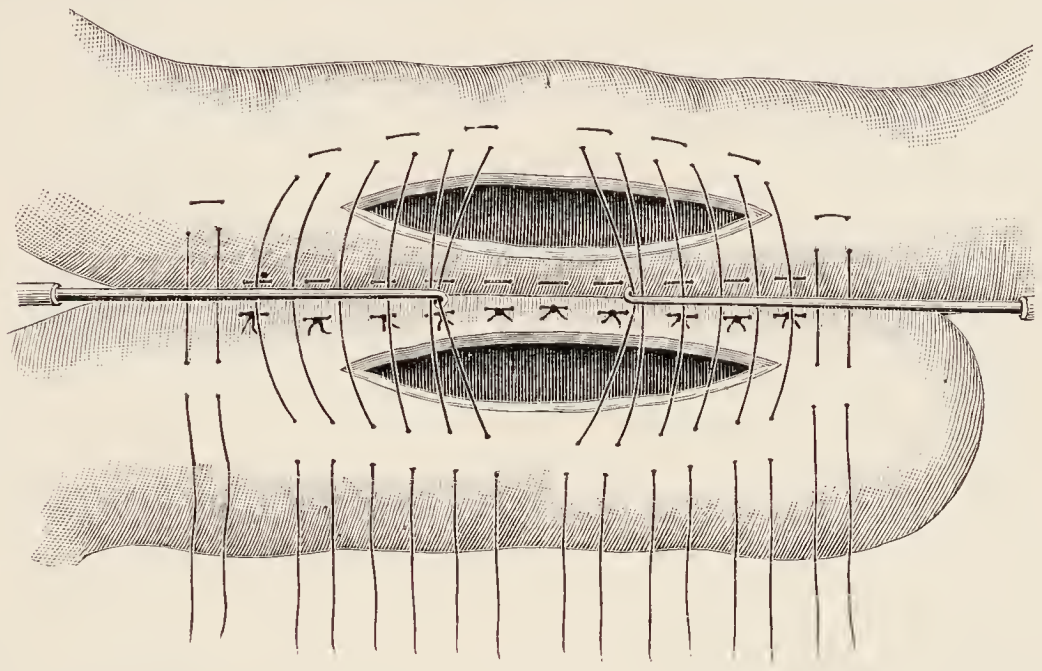


FIG. 850.—Lateral anastomosis, Halsted's method. Incisions made and sutures laid for closing.

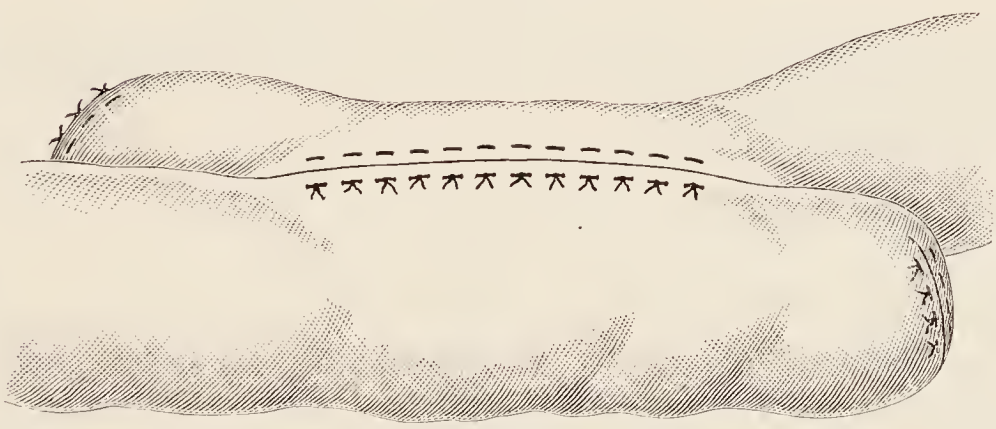


FIG. 851.—Lateral anastomosis, Halsted's method. Anterior row of sutures tied; operation completed.

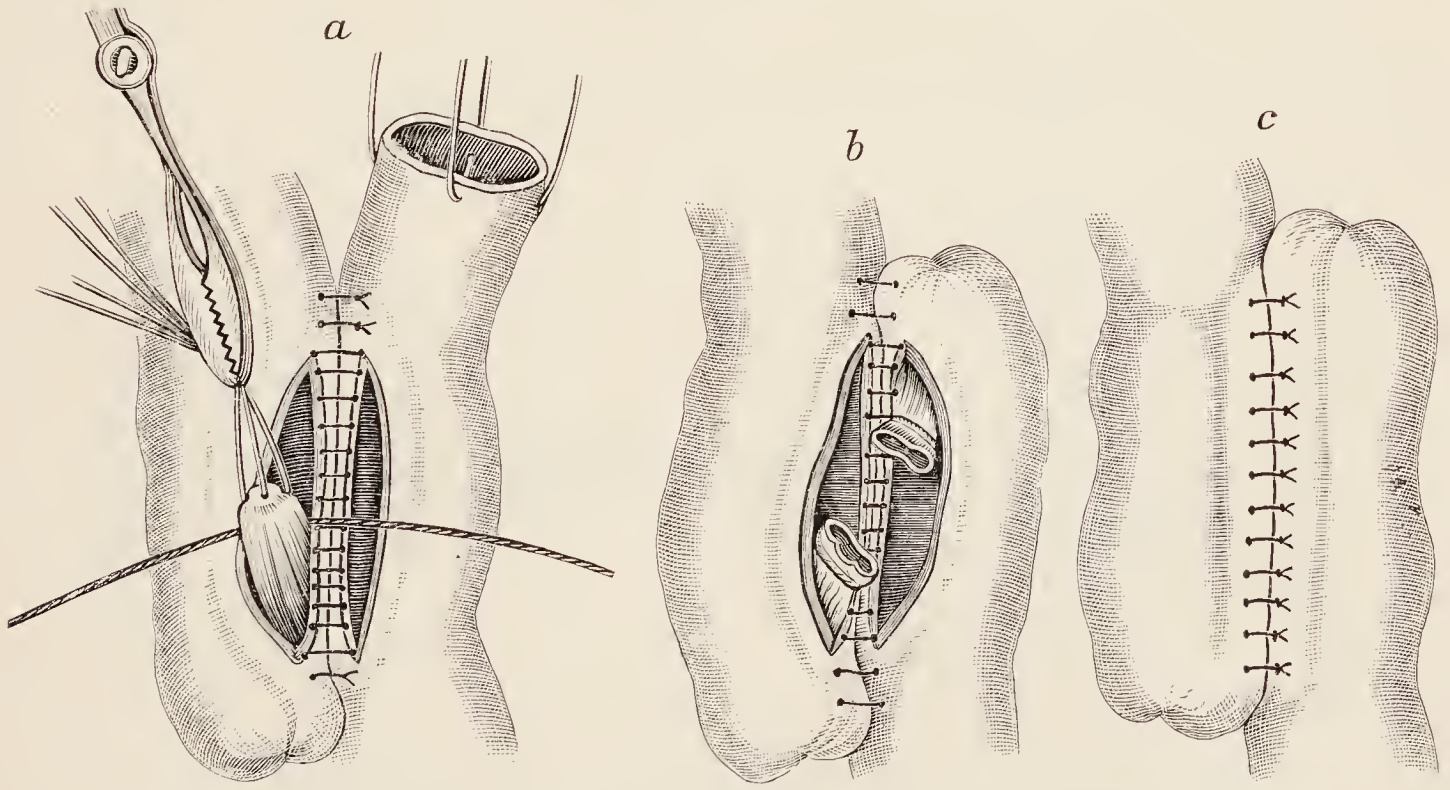



FIG. 852.—Lateral anastomosis, Maunsell's method.

*The Remarks.*—This method is simpler, easier, and more quickly practiced than is the preceding. The sutures necessary for the purpose should

be prepared in advance and the needles threaded before operation begins. The use of interrupted sutures instead of continuous is still another commendable measure. The submucous fibrous coat is included by the sutures.

*Maunsell* proposed the invagination of the open ends of the intestinal segments by means of sutures (Fig. 852) carried out through the anastomotic opening (*a*). The extremities of the invaginated portions are tied, dropped into the lumen (*b*), the opening closed, and the ends connected by a stitch or two with the contiguous bowel (*c*).

*The Comments.*—It is questionable if this be as good or a quicker way than sewing the open ends. The final fixation sutures are quite equal in all respects to those employed in the common method of closure.

**Lateral Anastomosis by Enterotome** (Grant).—A blade of the opened instrument (Fig. 853) is inserted into each segment of intestine and the

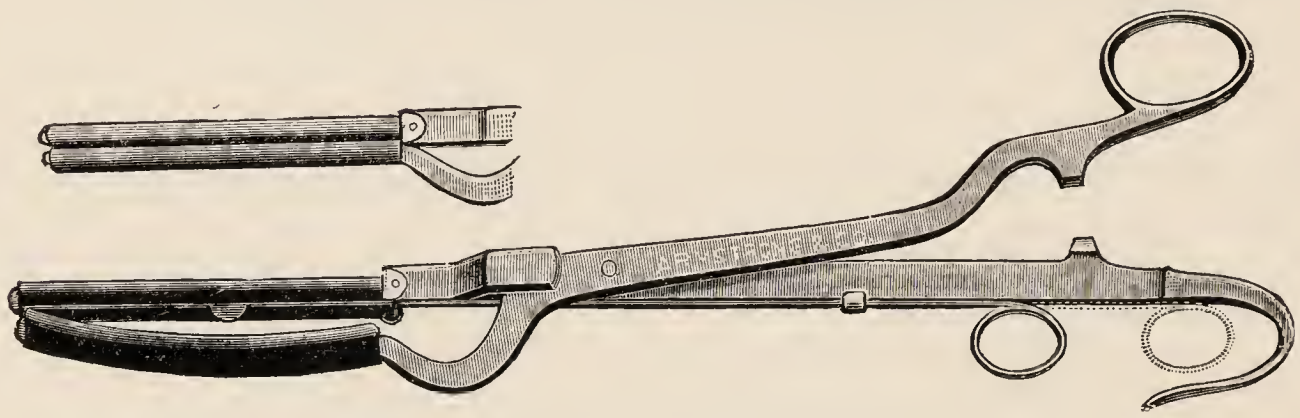


Fig. 853.—Grant's enterotome.

blades are closed, thus dividing the approximated wall and closely apposing the peritoneal surfaces for sewing, which is quickly accomplished (Fig. 854). Remove the instrument, invaginate the open ends, and close them by sewing.

*The Remarks.*—The instrument controls the tissues admirably while the sewing is being done, and also the bleeding. It facilitates the procedure and is, withal, a commendable device. *Wyeth* suggests, very properly, that the incision should be made not less than four inches in length.

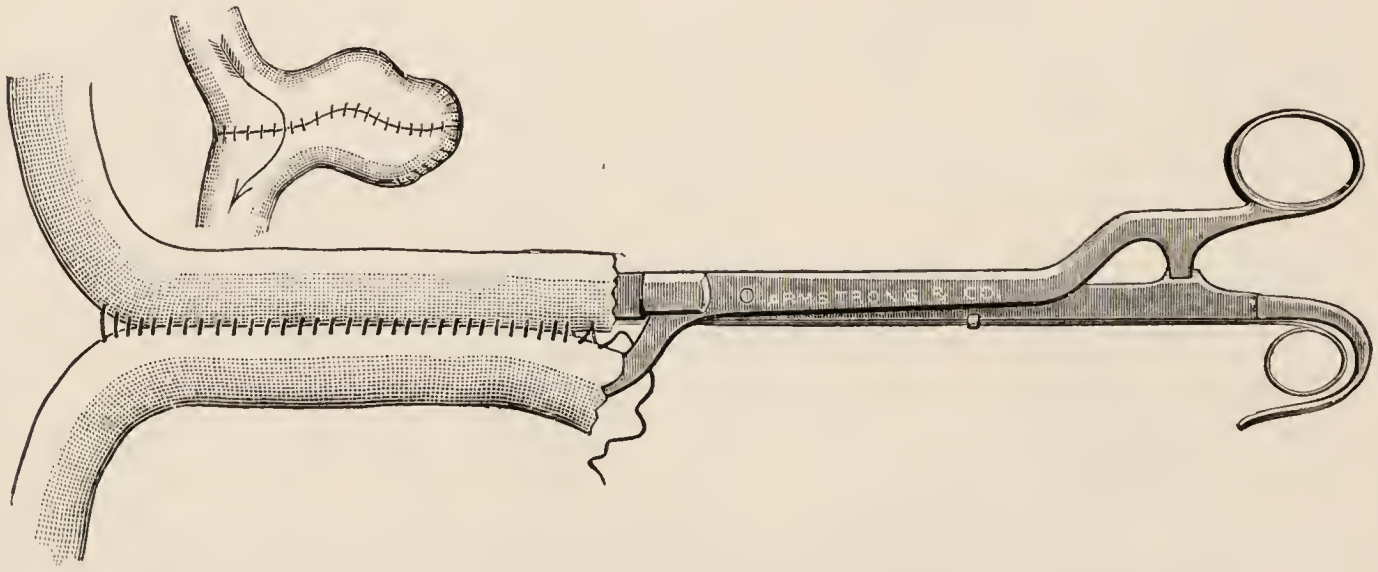


Fig. 854.—Grant's instrument, operation for lateral anastomosis.

**Lateral Implantation.**—Union by lateral implantation is the outcome of imitation of the anatomical arrangement at the junction of the ileum and colon. The end of the smaller segment is treated as described in Senn's

method of end-to-end joining by aid of the rubber band (Fig. 798). A longitudinal slit is then made in the colon and a quilt stitch is introduced primarily at the borders of the slit (Fig. 855) or by the way of the open end of the bowel through either border of the slit, thence through either side of the small proximal end of the gut; by these means the proximal end is drawn into the large intestine in such a manner as to cause inversion of the borders of the opening in the colon, thus bringing in contact with each other the serous surfaces of the respective intestines, which are then joined by a continuous suture applied at the border of external contact (Fig. 856). While this method of procedure is both practical and expedient, it still requires the knowledge of a more extended experience to establish its absolute worth.

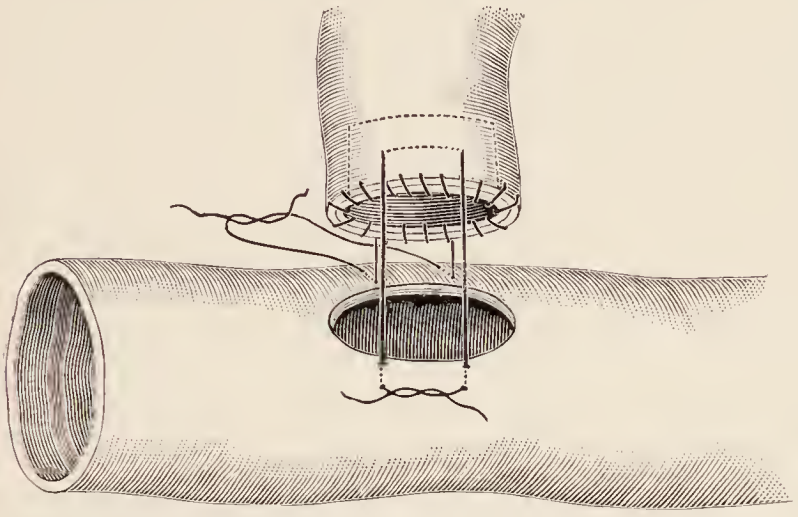


Fig. 855.—Lateral implantation by direct sewing, or through the open end of the colon.

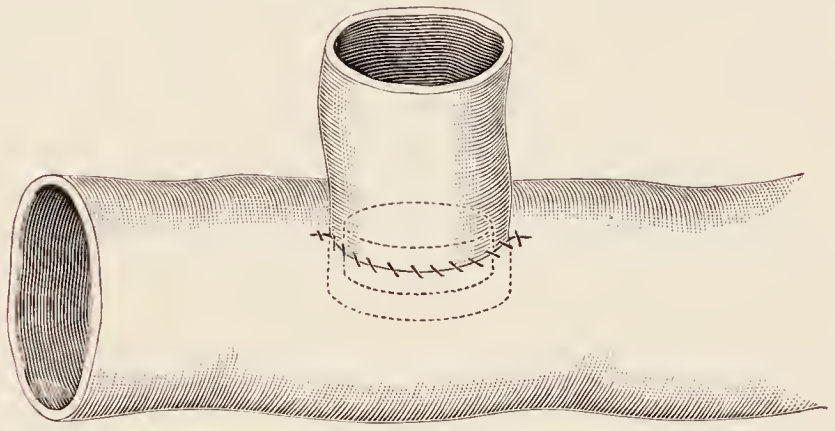


Fig. 856.—Lateral implantation, union completed.

If the end of the colon be open, one can proceed as follows: Pass long silk ligatures (four in all) through the ileum from within outward, then through into the colon, near to the edges of each of these intestinal openings (Fig. 857, *a*, *b*, *c*, *d*); tie them firmly, and pass the ends through the slit in the colon and out through its open end (Fig. 858, *a*, *b*, *d*); seize them with forceps and by gentle traction invaginate the apposed borders, causing them to appear below at the open

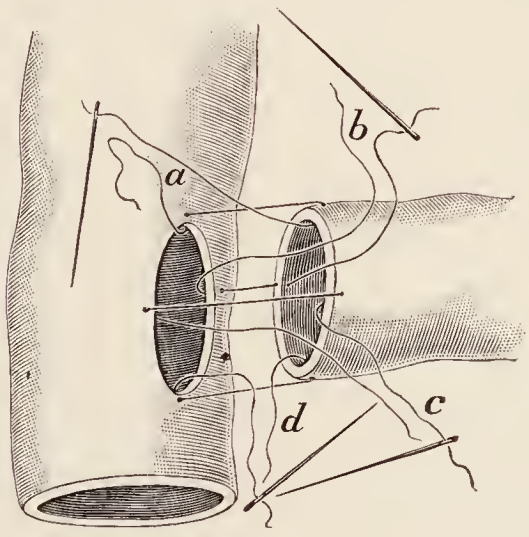



Fig. 857.

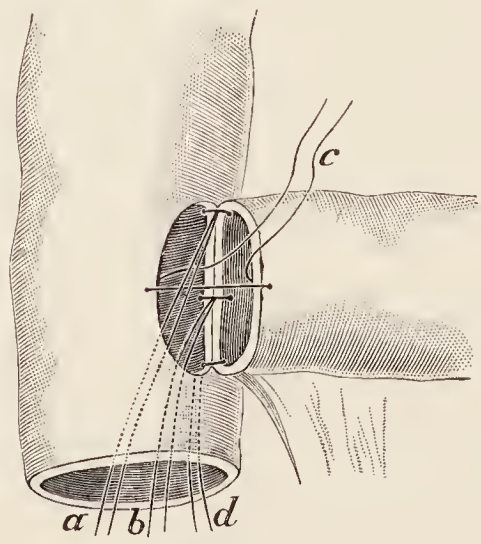



Fig. 858.

Fig. 857.—Lateral implantation, Maunsell's method. *a*, *b*, *c*, *d*. Sutures in position.
Fig. 858.—Lateral implantation, Maunsell's method. *a*, *b*, *d*. Sutures carried through open end of colon. *c*. Suture remaining behind.

end of the gut (Fig. 859); sew the borders as in Fig. 803; disinvaginate carefully, close the end of the colon, and fortify the line of junction externally with several sutures that include the sero-muscular coats of the intestinal walls (Fig. 860).

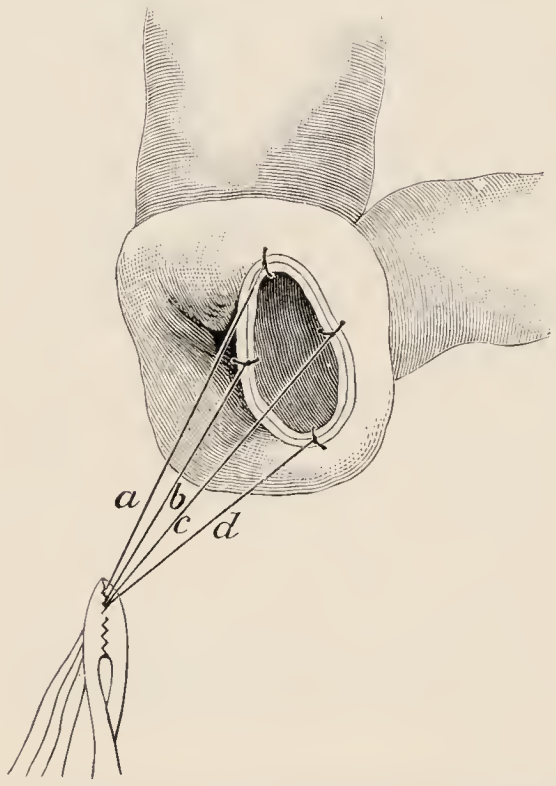



Fig. 859.—Lateral implantation, Maunsell's method. Borders invaginated.

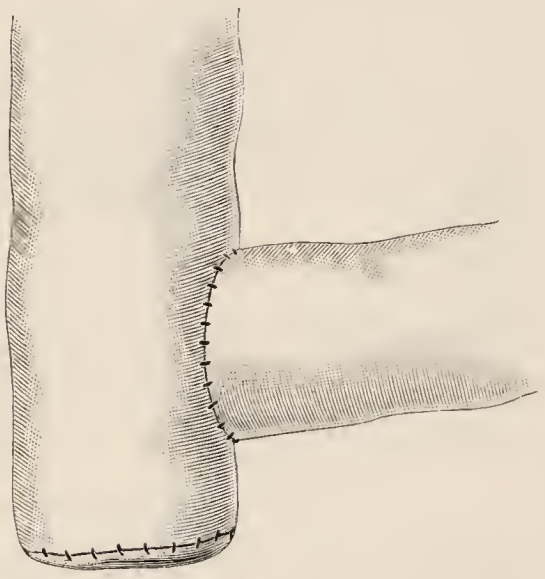


Fig. 860.—Lateral implantation, Maunsell's method. Openings closed, sewing completed.

*A choice of the preceding measures* will depend very much indeed on the skill and experience of the operator, and the condition and environments of the patient. If the condition of the patient demands rapidity of action, either the Murphy button, the bone bobbin, the bone or potato plates, or Maunsell's method can be employed, depending, of course, on the preparation and practical wisdom of the operator. If the time be not pressing, and the surgeon be favored with nimble and practiced fingers, the union by sewing is the method *par excellence* for adoption. It is impossible, however, to indicate any one measure as proper for universal employment. The securement of the greatest good to the greatest number invites and encourages the adoption of the means best fitted for the case in all respects.

**Abdominal Section for Wounds of Abdominal Viscera.**—Penetrating wounds of the abdominal viscera, due to gunshot and other forms of violence, are of frequent occurrence in civil life. The hollow viscera suffer most frequently, and the evil effects incident to their injury are prompt, pronounced, and self-evident. Hæmorrhage due to severance of important vessels, and peritonitis dependent on the escape of irritating and infecting agents into the peritoneal cavity, are the deadly factors against the influence of which the wisest surgical contention so often proves of but little use. The inability to promptly remove these agents, or master all their influences, often causes the efforts of the surgeon to appear useless, or even destructive, to untutored observation. However, the increasing number of favorable results in heretofore hopeless cases, following prompt, aggressive, aseptic procedure, have transferred a mere hope of success, based on last resort, to the field of established surgical action.

**Abdominal Section in Penetrating Gunshot Wounds.**—The early dangers in this form of injury relate to hæmorrhage and peritonitis in the order

mentioned. Hæmorrhage is arrested here as in other parts of the body, although with greater difficulty on account of the number and complexity of the structures involved. For the proper treatment of this variety of wound it requires, in addition to thorough aseptic procedure, a knowledge of the point of entry and the size and direction of the missile, facts which should be carefully ascertained before operation, if time and opportunity will permit. The point of entrance to the peritoneal cavity is ascertained best and safest by means of a careful dissection made in the course of the bullet. The too common practice of exploration of the wound with the finger or probe should be carefully employed or avoided entirely, since it is frequently unavailing and even injurious from the first, and may cause the introduction into the walls of the wound and into the peritoneal cavity itself of foreign bodies and infecting influences.

*The Abdominal Incision.*—Whether the incision should be made at the median line of the abdomen or at the seat of the injury is a matter largely controlled by the situation of the point of entry and direction of the missile, the presence of hæmorrhage, and also the personal preference of the surgeon. If symptoms of hæmorrhage be present, the median incision offers the best opportunity for the detection and arrest of bleeding points and the removal of blood from the peritoneal cavity. If the direction of the abdominal wound, irrespective of the point of entry, indicates that the ball has gone toward the median line, the median incision is indicated. However, if this point be outside the borders of the rectus abdominis, and the course of the missile be obliquely outward in direction, instead of backward, upward, or downward, and symptoms of hæmorrhage be absent, a vertical incision at the point of entry may suffice. Finally, it should not be forgotten that rapidity of action and unobstructed observation are the essential requirements for the prompt detection and arrest of bleeding points, as well as for the detection and closure of intestinal wounds. Therefore, an embarrassing or ineffective incision should be promptly supplemented by a better one when circumstances will permit. In either instance the incision should be of sufficient length and so directed as to facilitate the requirements of the procedure. The borders of the incision are held widely apart by means of suitable retractors or by traction sutures passed through their entire thickness.

Ordinarily the free separation of the borders exposes to view the omentum marked with evidences of traumatism, as exhibited by the presence of extravasated blood, and perhaps of bleeding points. If the wound be a simple one, the bleeding points are closed by silk ligatures and the omentum is turned aside so as to expose to view the blood, escaped intestinal contents, and intestinal wounds that may be contiguous to it. Blood and foreign matter thus exposed should be carefully removed by wiping with soft sponges, which are changed or thoroughly cleansed after each act.

*The Detection and Arrest of Hæmorrhage.*—Ordinarily any considerable hæmorrhage will have ceased before the opportunity for operation arrives, either by Nature's efforts or the death of the patient. If there be reason to believe that dangerous bleeding still continues, prompt measures for its

arrest should be instituted. On the other hand, if only insignificant bleeding be present, the examination for intestinal wounds should begin at once, and the bleeding points should be arrested as soon as found. The search in the abdominal cavity for bleeding vessels and the control of hæmorrhage is a perplexing matter, especially if the demand be urgent and intestinal wounds be apparent and for the time irremediable. I am disposed to advise that pressure upon the aorta, by means of the hand passed upward through the wound to the diaphragmatic opening for that vessel, should be made at once in such cases to arrest the hæmorrhage; and, if admissible, that the pressure be maintained until the intestinal wounds are at least temporarily closed, after which the bleeding points can be secured without the danger of further peritoneal infection from this source.

Hæmorrhage from wounds of the stomach, intestines, mesentery, and serous surfaces generally, can usually be well controlled by means of large, fine sponges pressed firmly into place and held there by the hand of an assistant, while the surgeon cautiously releases them in order from below upward, catching and closing the bleeding points with fine silk thread as they appear. The bleeding points can be secured by direct ligation as in other tissues of the body, or by transfixion and tying, transfixion being the more expedient in mesenteric wounds. In the latter instance, however, the inclusion of vessels other than the injured one may cause localized gangrene of the intestine. *Murphy* has demonstrated on dogs the importance of their parallel artery (page 654). If hæmorrhage be due to injury of the solid viscera, the expedients of relief will be somewhat different and likewise urgently demanded. Hæmorrhage from the liver is arrested either by closure of the wound, by sewing, by actual cautery, or by tamponing with iodoform gauze; the spleen and kidney may be treated in a similar manner, or the bleeding points clamped for temporary control and the wounded organs removed later, if necessary, for the arrest of hæmorrhage.

*The Search for Intestinal Wounds.*—The search for intestinal wounds must be conducted with great caution, and with the aid of a good light (Figs. 103 and 861, *o*), otherwise one or more may pass unobserved; and fæcal infection, due to escape of intestinal contents, will follow incautious handling. After proper control of hæmorrhage, the loop of intestine nearest the point of peritoneal perforation is carefully raised and examined, beginning at the part of the intestine farthest from the course taken by the missile, passing along and closing each opening as soon as found with a suitable clamp (Fig. 861, *b* and *k*), or, better still, perhaps, securing them for the time with pressure forceps, and giving them in charge of an assistant. Any infecting material or blood should be wiped away as soon as noted. If it be necessary to remove the intestine from the abdomen for examination, it should be quickly surrounded with rubber tissue covered with aseptic gauze saturated with hot saline solution, and kept thus protected until returned.

*The Comments.*—If the escape of intestinal contents has already happened in a considerable degree, a gentle stream of the saline solution is caused to flow continuously across the examination field, thus washing away at once the obnoxious products. The passage of some of the fluid between

intestinal folds need not be regarded with fear of further infection, for in such cases abdominal irrigation is commonly employed as a protective measure; and, too, the warmth of the fluid exercises a salutary effect on the injured tissues and on the patient as well. We are of the opinion that it is better to temporarily close the openings than to treat them finally as soon as found. By the former method they are secured before the height of peristaltic action, excited by the exposure and handling, is attained. This is a manifest advantage, since the peristalsis not only changes the comparative relations of the openings. but also causes further escape and dissemination of infecting agents. To each of the retaining clamps a string should be attached, one end remaining without, to serve as a guide to the intestinal wounds. If, after securing the openings, the condition of the patient will warrant, it is better to eliminate at once from the peritoneal cavity, by means of hot saline or sterilized fluids, all blood clots and infecting matter, rather than to risk the danger of more extended dissemination of these products, due to increased peristalsis and unavoidable manipulation. It is difficult indeed to express the proper degree of haste to be exercised, except by saying that each case must be treated in accordance with its own demands, always remembering that an undetected perforation will of itself almost certainly destroy the patient. During the handling of the intestine, the coils adjacent thereto should be carefully protected from all deleterious influences by broad aseptic sponges and pads, or abundant aseptic gauze.

The average number of perforations in a gunshot wound of the intestines is between five and six. Contused and lacerated gunshot wounds of the bowel require the same consideration as the penetrating. The use of hydrogen gas for the discovery of intestinal perforations is strongly advocated by Senn. In common with many others, the author is not disposed to advise its employment in the general manner advocated by that eminent surgeon. The intestinal distention thus caused, together with the liability of extrusion into the peritoneal cavity of infecting intestinal agents, may be regarded as strong objections to this method of practice. However, the author can commend its employment when it is addressed to a limited portion of the intestinal tract, for the purpose of detecting not the first, but rather the last, or as yet an undiscovered perforation.

*The Repair of the Intestinal Wounds.*—The proper repair of the intestinal wounds requires an anatomical knowledge, at least, of the visceral attachment of the mesentery. The two layers of the mesentery separate as they approach the jejunum and ileum, forming a triangular-shaped space about three fourths of an inch long, with a base about a fourth of an inch wide, which is formed by the uncovered muscular coat of the intestine. This space contains fat, delicate fibrous tissue, and the vessels and nerves of the intestine (Fig. 811). If care be not taken in sewing the intestine at the mesenteric border (Fig. 811), especially in the use of the Lembert suture, imperfect apposition of the borders at that point will be followed by the escape of intestinal contents into the triangular space and thence into the peritoneal cavity. The terminal parallel branches of the superior mesenteric artery are found here, each running directly to a more or less independent area

of intestinal distribution, the shortest branches—one third of an inch long—being at the termination of the ileum. Since these branches arise from the final loops of the mesenteric artery and are comparatively independent of each other, the loops should be treated with great consideration, otherwise the nutrition of the intestine may be impaired. *Murphy* has shown that the parallel artery of the dog's bowel will nourish for forty-eight hours six and a half inches of intestine when the straight branches that supply it are tied. However, if the circulation of this and the corresponding straight terminal vessels be arrested by ligature, gangrene of the intestine will ensue if the circulation of more than half an inch of the intestine be involved.

*The thickness of the muscular coat* of the intestine varies in different subjects and in different parts of the organ, being thickest at the upper part of the jejunum—one twentieth of an inch—and thinnest at the lower portion of the ileum—one fortieth of an inch. The submucous fibrous tissue is an important element of strength in sewing, since it is tough and impervious to air or water. The importance of including it within the stitch, and its proximity to the mucous membrane and glands within the intestine, emphasize the necessity of cautious technique in sewing, to obviate involvement of the intestinal lumen. Cambric needles armed with colored silk should be employed for intestinal sewing (Fig. 861, *e*). These needles separate rather than sever the tissue, thereby limiting the liability to hæmorrhage, and providing a small, firm stitchhole. The use of colored silk enables the surgeon to quickly distinguish the sutures and the silk thread as well. Fine aseptic thread of any variety of texture can be employed in cases of emergency.

*The special importance of the intestinal wounds* relates to their nature, size, contiguity, and situation. Lacerated and contused wounds characterize gunshot injuries of the intestine. If the impingement be but trifling, a contusion is caused; if greater, laceration ensues with or without penetration; if the latter happen, the intestinal mucous membrane protrudes. Size and contiguity are important elements, since wounds of large size and contiguous to important structures often require sterner measures of treatment than do their antitheses. The situation of the intestinal wound is of major importance, and often measures the distance between simple expeditious operative procedure and the reverse of this practice.

*In the repair of the intestinal wounds* a strict aseptic *régime* must be practiced: abundant sponges, gauzes, iodoform, hot saline, and medicated solutions must be prepared and at hand. Numerous aseptic towels moistened with antiseptic fluids should environ the immediate seat of the operation and be changed whenever soiled. It may be well to repeat that vigorous sponging of a serous surface, and the application thereto of strong solutions of corrosive sublimate or carbolic acid, produce a traumatic effect on the epithelium which not only provokes inflammatory action, but impairs the physiological functions of serous structures, thus hastening the onset of deleterious processes and weakening the power of resistance and restoration. The portion of intestine undergoing repair is isolated by means of soft, flat sponges wet with the hot saline solution, or by gauze pads (Fig. 66) simi-




FIG. 861.—Instruments employed in intestinal repair.

*a*. Scalpel and bistouries. *b*. Forcipressure. *c*. Needle forceps. *d*. Scissors. *e*. Needles threaded with colored silk. *f*. Rubber tissue around wicking for drainage, and a piece of rubber tissue. *h*. Glass and rubber drainage tubes. *i*. Sponge-holder. *j*. Tenacula. *k*. Clamps for intestinal openings. *l*. Dissecting and mouse-tooth forceps. *m*. Rubber band and catgut. *n*. Sponge with string attachment. *o*. Electric light. Openings are cut in drainage agents to suit the operator.

larly treated. A weak antiseptic solution may be used instead. Infecting agents are carefully wiped away by a soft, clean sponge; the intestinal contents are pressed away from the opening and retained by agents devised for the purpose (Fig. 868), or by the thumbs and fingers of the surgeon, or by an assistant (Fig. 871), who thereafter carefully holds the intestine, with the lumen compressed, in a convenient manner for the operator.

After inversion of the protruding lips of the wound, penetrating wounds, at all aspects of the intestine except the mesenteric border, can be properly closed by the continuous suture of Dupuytren or Cushing (Figs. 782 and 786), the latter being the more hidden when drawn in place. The interrupted sutures of Lembert (Fig. 862) and Halsted (Fig. 793), while equally efficient, are less quickly applied than the continuous varieties. Interrupted sutures are placed from a sixth to a tenth of an inch apart, and should include, like the other varieties, the submucous fibrous tissue of the bowel. Not infrequently two rows of sutures are applied; the first is interrupted, the last is usually continuous, and penetrates the tissues less deeply than the former, which, when tightened, it entirely obscures. After closure the surface is sopped clean with the saline fluid or sterilized water, and a small amount of iodoform is sometimes applied with the finger along the line of union. The contused wounds should be treated in the same manner as lacerated wounds, because the contused portion is liable to slough and expose the patient to peritonitis and all of its dangers. *Either longitudinal or transverse closure of an intestinal wound can be practiced;* the former, however, should not be employed at the mesenteric border, or elsewhere when the lumen of the bowel is reduced by the sewing to less than one half of its normal size (Senn). Transverse sewing interferes with the nutrition of the bowel less than the longitudinal, especially when contiguous to the mesenteric border. If this border or the mesentery be wounded so as to destroy the circulation, resection of the intestine corresponding to the seat of the injury must be practiced on account of the imminent danger of sloughing. A limited injury may be repaired by transverse sewing, supplemented perhaps by the union of the ends and borders of a longitudinal incision (Fig. 863), so as to cause moderate bending or elbowing of the gut (Fig. 864). If a large opening, or a slough, or numerous contiguous injuries of this nature be present

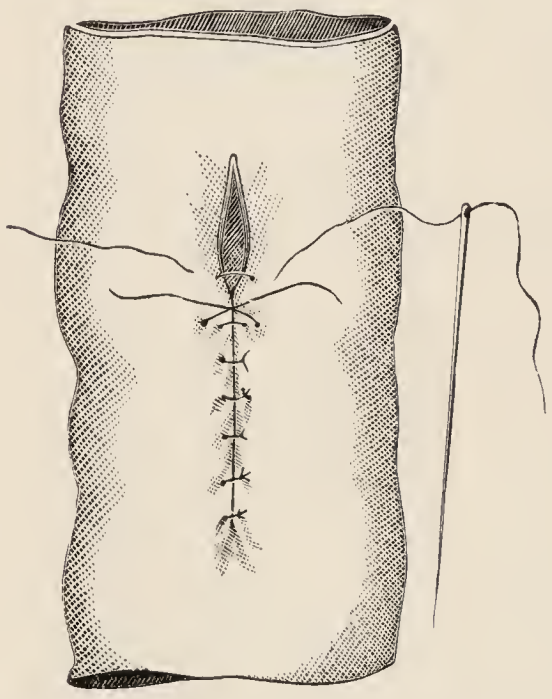


FIG. 862.—Lembert's interrupted suture.

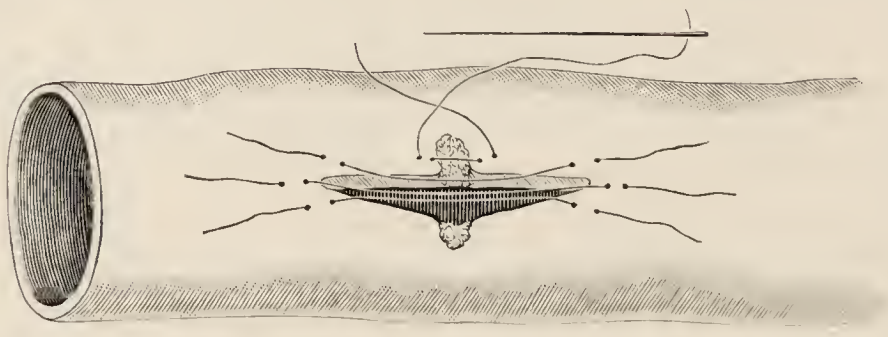


FIG. 863.—Longitudinal division of transverse defect. Sutures placed for union.

at the free border of the intestine (Fig. 865), proper repair can be consummated by the process of "elbowing" (enteroplasty, page 673), either with or without removal of the damaged tissue. An incision two or more inches in length, according to the area of the injury, is made lengthwise in the gut, the center corresponding to that of the injury (Fig. 863). The latter is then repaired at either side of the incision by sewing (Fig. 866), after which the bowel is bent or "elbowed," so as to bring corresponding portions of the longitudinal incision in contact with each other, in which position they are united. This plan turns the defects inward and still main-



FIG. 864.—Transverse sewing for repair of defect. Longitudinal division of defect turned in, causing slight elbowing.

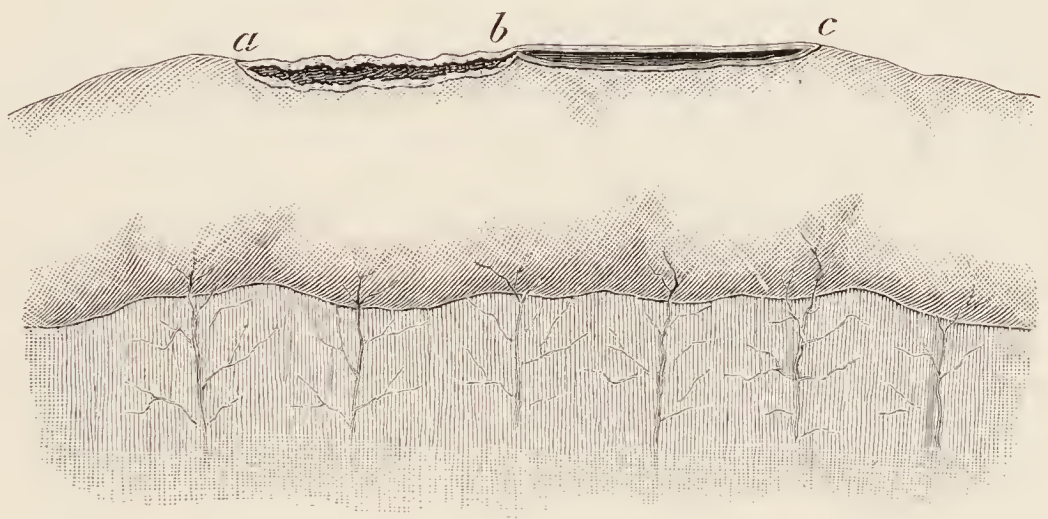



FIG. 865.—Repair by decided elbowing. *a, b, c.* Borders of defects trimmed.

tains a proper sized lumen, thus obviating the necessity of resection of the intestine, a manifestly dangerous alternative in the presence of inexperience and pressing demand. Elbowing should not be practiced at the mesenteric border on account of the operative difficulty, the danger of sloughing attending it, and also the liability of subsequent kinking of the gut, none of which conditions are pronounced in convex-border elbowing.

*Chaput* advised stitching over the area of an impending perforation the surface of a contiguous intestine. This is an ingenious proposition, and may no doubt prove effective under special contributing circumstances.

*In wounds of the omentum and mesenteric* hæmorrhage is arrested, the borders of the wound are inverted, and the opening is closed by sewing. If the omentum be greatly

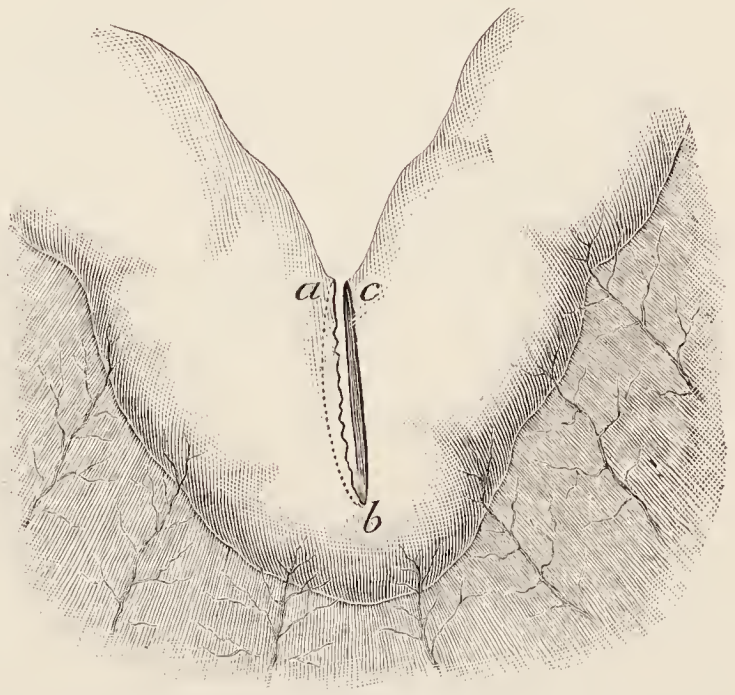



FIG. 866.—Repair by decided elbowing. *a, b, c.* Borders in position for sewing.

damaged, or if it and the mesentery are infiltrated with blood, the omentum is removed above the seat of injury after ligature with silk, and the wound of the mesentery is closed after the evacuation of the extravasated blood and the arrest of hæmorrhage.

**Resection of the Small Intestine** (Enterectomy).—In those cases in which the injury is too extensive to admit of simple means of repair, or the circulation of the mesenteric border is destroyed, or extensive disease has taken place, etc., the removal of a portion of the intestine becomes necessary. The amount to be removed may vary from half an inch to many feet. In cases of multiple injury of the intestine, it is wiser to perform a single enterectomy, even though a limited amount of uninjured intestine be sacrificed, than to practice double enterectomy with the view alone of saving a greater amount of intestine, for the unfavorable influence of time and exposure on the final outcome of the case is of greater significance than the sacrifice of the intervening uninjured portion of the bowel.

The resection of intestine is not a difficult procedure, but the repair of the resulting wound is quite another matter. Milliners' needles (Fig. 861, *e*), with points sufficiently blunted to permit easy recognition of the piercing of the submucous fibrous coat, armed with fine twisted aseptic colored silk, are the best for sewing. When circumstances will permit two lines of sutures are usually employed, one, the interrupted, the other the continuous variety, the last of which is outermost and properly causes concealment of the former. Differently arranged sutures used combinedly give greater security than does the like use of similar ones. *The interrupted suture permits* dis-




Fig. 867.—The effect of distention on union with interrupted suture. *a*. Before distention. *b*. After additional sutures added.

tention at the seat of sewing (Fig. 867), the continuous hinders it; the interrupted contributes but little to contraction, the continuous much, unless great care be exercised in the introduction; the integrity of the union by the interrupted is often practically affected by changes in caliber of the gut, that of the continuous is made insecure by subsequent contraction; infection

by capillarity is limited in the interrupted to perhaps a single stitch, in the continuous it may invade the entire length; interrupted stitches are cast off independently of each other, the continuous suture remains until the final stitch is liberated.

It is apparent, therefore, that these varieties serve well together and that the continuous suture should be applied last. The pushing aside of the

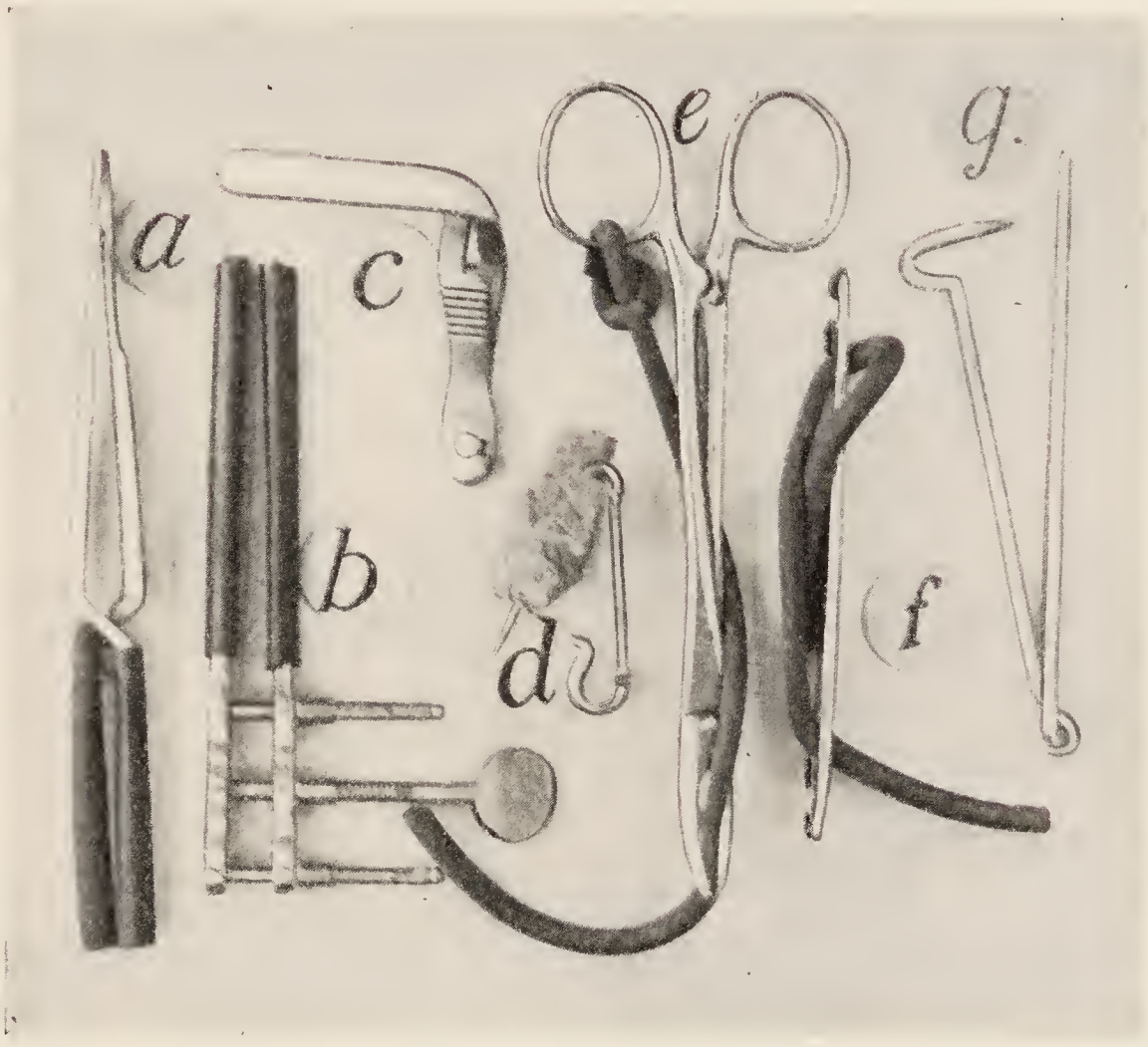



Fig. 868.—Means employed to restrain intestinal contents. *a*. Self-closing forceps, blades protected by rubber tubing. *b*. Billroth's clamp. *c*. Murphy's clamp. *d*. Maunsell's safety pin and sponge clamp. *e*. Jeannel's rubber tube and forcipressure clamp. *f*. Heinake's clamp. *g*. McLaren's clamp.

contents of the intestine and the prevention of the return during repair are matters of great importance. This purpose can also be accomplished by means of narrow strips of iodoform gauze passed around the gut through an opening made at the border of the mesentery, and tied. Rubber bands (Fig. 878) may be employed in a similar manner (Senn). Flat pieces of sponge wrapped around the gut and having their ends pinned together with a safety pin passed so as to include the border of the mesentery (Maunsell) (Fig. 868, *d*), are efficient. Finally, though less effective and convenient, the fingers and thumbs of an assistant may be called into use for this purpose (Fig. 871). Various measures are advised to properly control the extremities of the intestine during the act of sewing. The introduction of traction loops at points a short distance from the respective ends (Fig. 869), in such a manner as to cause parallel ridges through which the needle can be readily passed, is an effective and ever available means.

*Kocher's Method of Resection.*—Draw well out of the peritoneal cavity the portion of intestine to be removed, exposing healthy intestine for a con-

venient distance at either end of the impaired part; pack carefully around the exposed bowel soft sponges or gauze saturated with the hot saline solution, so that any further peritoneal infection will be prevented; press away from the resection area with the thumbs and fingers the intestinal contents, and at the limits of displacement apply suitable clamps (Fig. 870) to the intestine at right angles with it or with outward divergency (Fig. 870, *b*,*e*) so as to obstruct the lumen of the gut and prevent the return of the contents to the evacuated area. Divide the intestine at right angles with its long axis or with slightly outward divergence through well-nourished structure at points about three quarters of an inch inside the clamps with blunt-pointed scissors; sever the mesentery from the wall of the bowel with scissors passed along the base of the interperitoneal triangu-

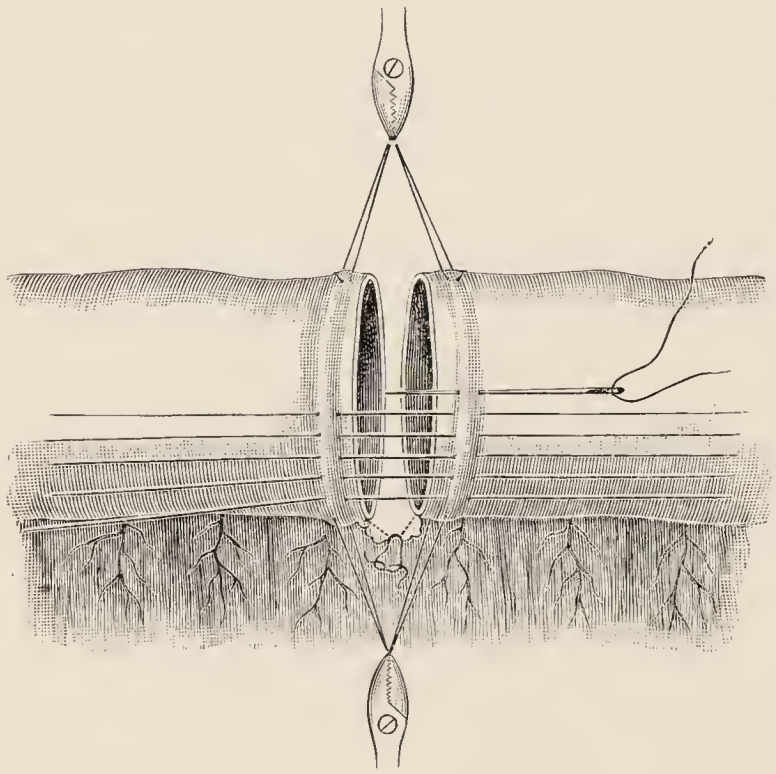


Fig. 869.—A method of control of the ends in intestinal sewing.

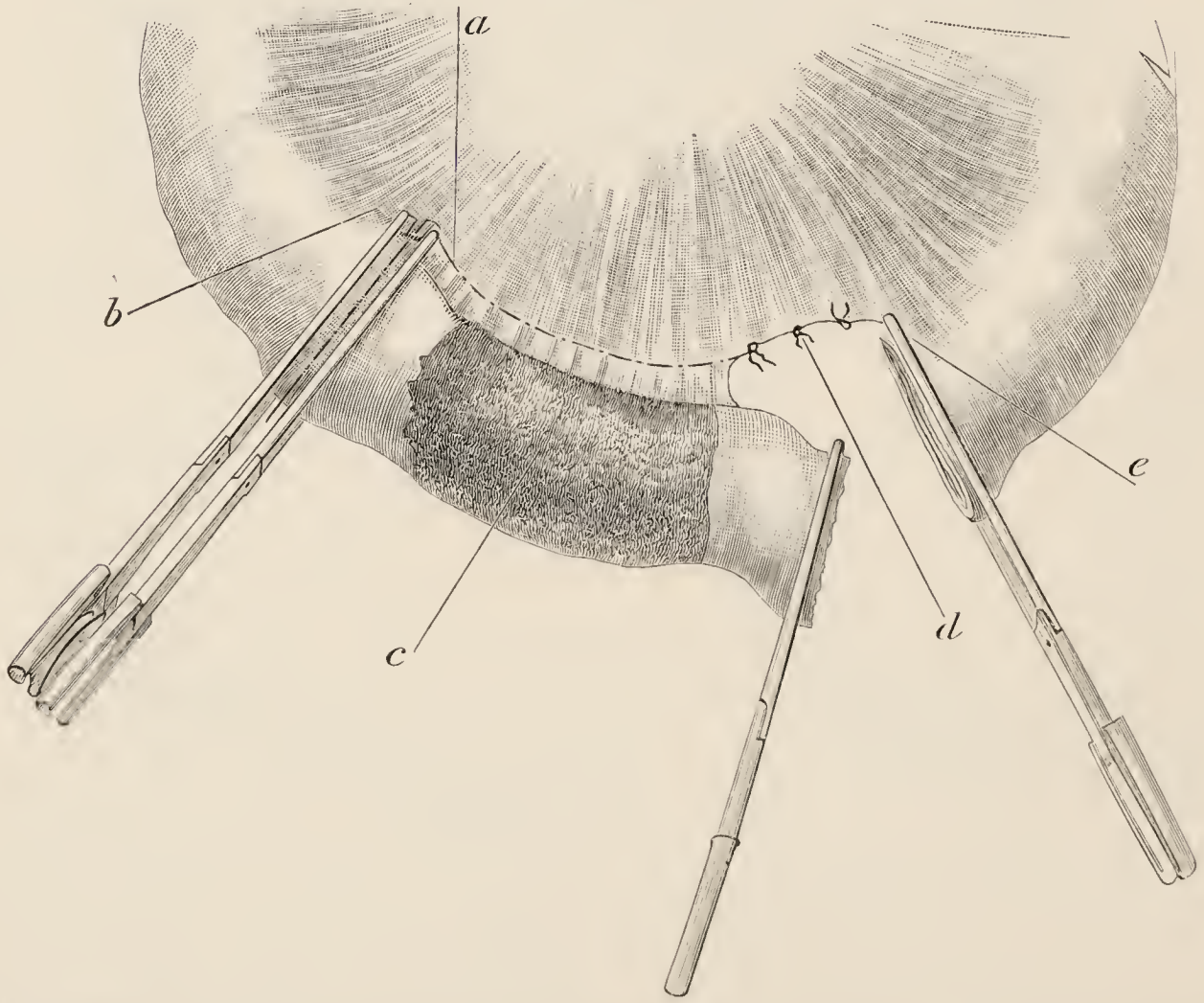



Fig. 870.—Resection of the small intestine, Kocher's method. *a*. Line of division of omentum. *d*. Sutures applied. *b*, *e*. Oblique line of section. *c*. Diseased area.

lar space, catching the bleeding points as they appear, thus relieving the excised portion from its attachments and allowing it to fall away with each

extremity securely clamped. Cleanse the parts thoroughly, substitute fresh packings, ligature the mesenteric vessels, and turn in and sew with continuous suture the border of the mesentery (Fig. 870). Then bring the

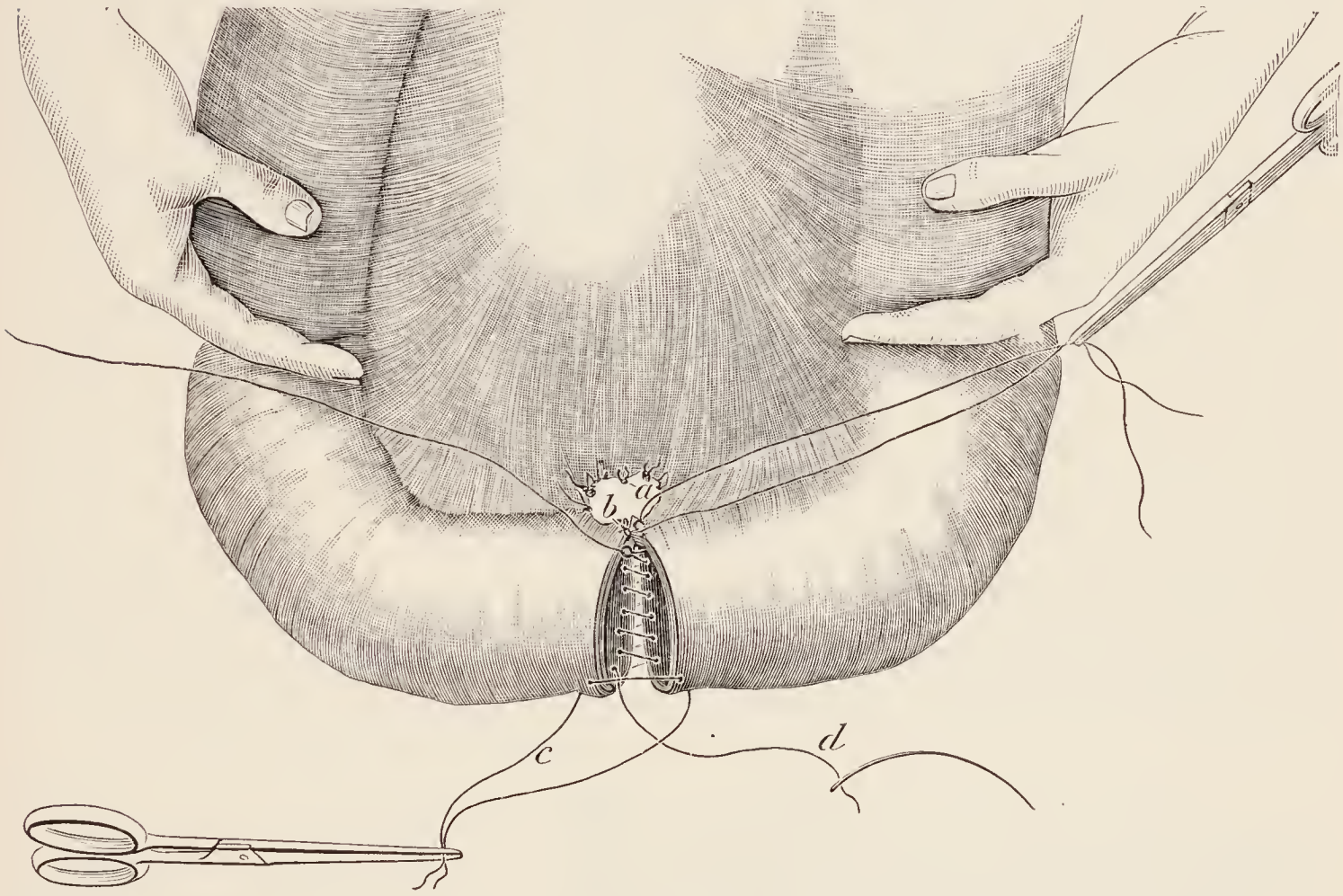



Fig. 871.—Resection of intestine, Kocher's method. *b*. Tied border of mesentery. *a*. First fixation suture. *c*. Second fixation suture. *d*. Posterior continuous suture.

ends of the divided bowel near together, pass a fixation suture through the sites of mesenteric attachment of both (*a*), and another through the opposite borders at their extremities, to secure accurate apposition of corresponding parts of the intestine (*c*). The fixation sutures do not pass through the intestinal wall, but include the serous and muscular structures of the intestine only, and when pulled on in opposite directions closely approximate the divided ends throughout. A continuous sewing (fixation) is now begun at the mesenteric border, including the entire thickness of the intestine, and taking a wider grip of the serous than of the mucous layer (Fig. 871). The first loop of the suture is tied and the passive end left long for subsequent use (*d*). Then, beginning behind, the

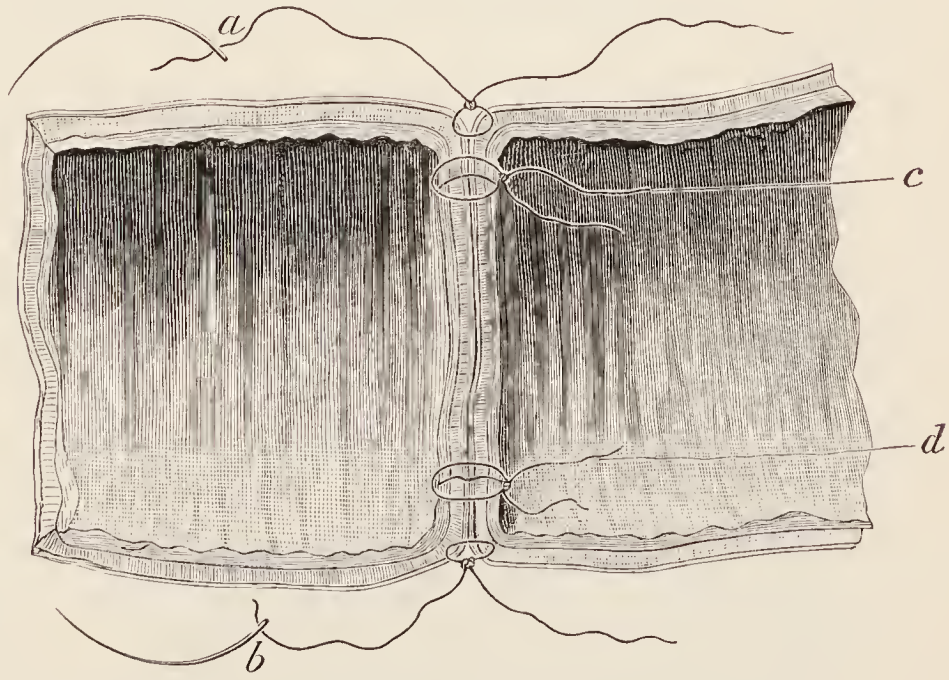



Fig. 872.—Resection of intestine, longitudinal section, Kocher's method. *a*. Anterior serous suture knotted. *b*. Posterior serous suture knotted. *c*. Deep suture, mesenteric attachment. *d*. Deep suture, free border.

borders of the gut are united firmly together by a continuous suture formed of the remaining end of the loop, and passing through the entire thickness of the walls of the divided ends around their entire circumference, finally being tied with the passive extremity, thus firmly and securely closing the intestinal canal. Cleanse the line of suturing and also the exposed intestine, and provide fresh packings if necessary. Then, commencing—knotting, as before—at the convex border (*b*, Fig. 872), introduce an external posterior suture along the line of the deep one, including the serous and muscular coats only, tying it finally to the passive extremity of the anterior suture (Fig. 872,*a*). Then introduce anterior suture, tying to free end (*b*). The opening in the mesentery is closed by sewing together its borders, or by folding and stitching in place. The parts are then cleansed with hot saline solution, packing is removed, and the intestines are returned to the abdominal cavity. Although the mucous membrane protrudes freely after division of the intestine, the protrusion should not be trimmed. The first row of sutures may include only the mucous membrane itself, the continuous form being preferable there. Two additional external rows are often applied, the first the interrupted, the second and final the continuous form. If the patient's condition requires prompter action, the last two only need be employed.

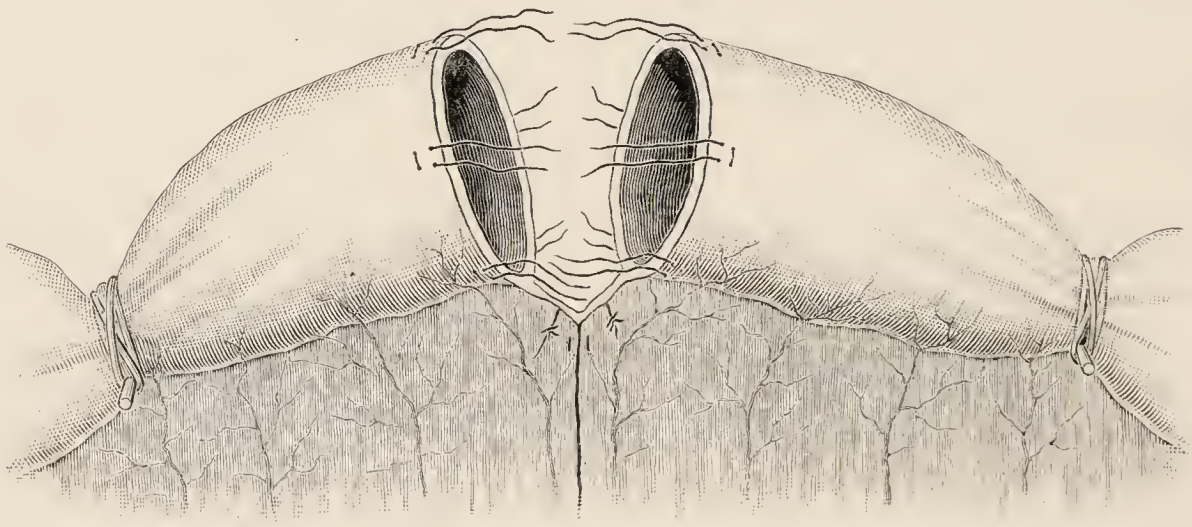


FIG. 873.—Resection of intestine, Halsted's method. Rubber bands and presection sutures in position.

*Halsted's Method of Resection.*—The portion to be resected is isolated as in the preceding instance, and the contents are pushed aside and retained by rubber bands carried around the intestine and fastened by looping (Fig. 873). The lines of incision are so directed as to secure for each end of the bowel free arterial supply which is carefully protected throughout from injury. Before removal is begun "presection" sutures, usually six in number, are introduced, just outside of the proposed lines of division in the manner indicated in the illustration. These sutures serve to bring the ends together (Fig. 874),

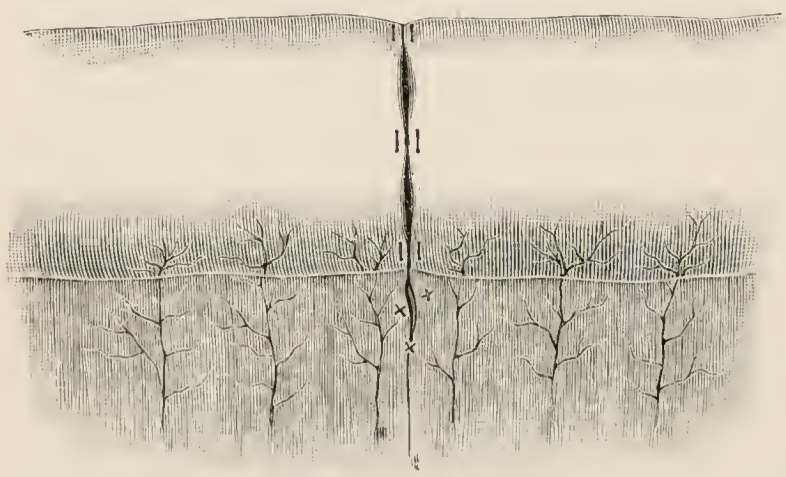


FIG. 874.—Resection of intestine. Halsted's method. Presection sutures tied.

thereby facilitating the final sewing. The mattress sutures are now introduced, piercing, but not passing through the submucous fibrous coat, and

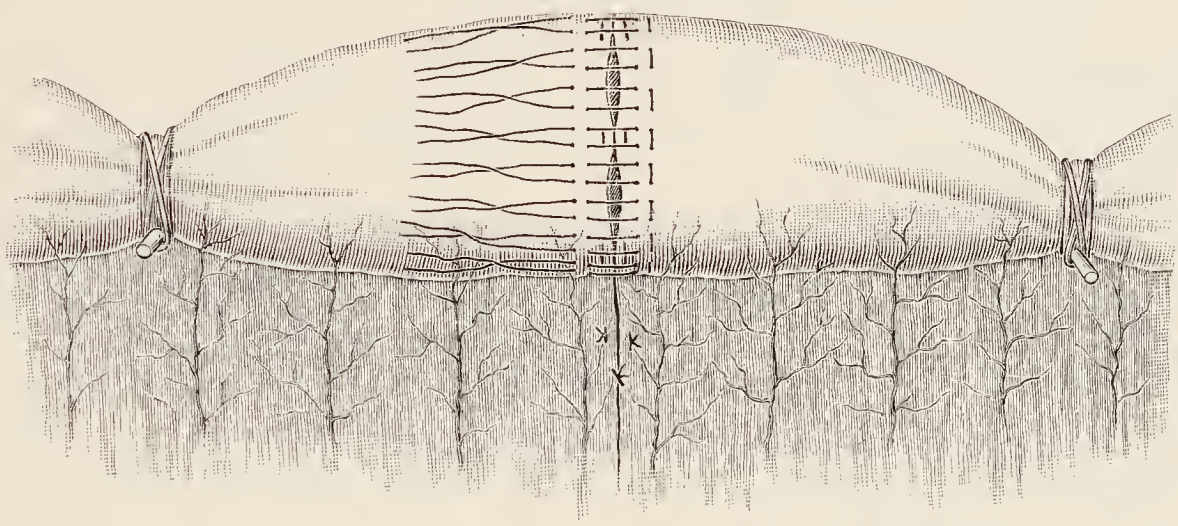


FIG. 875.—Resection of intestine, Halsted's method. Halsted's mattress sutures placed.

tied (Fig. 875). The slit in the mesentery is cautiously closed so as not to impair the vascular supply of the intestinal extremities (Fig. 876). Halsted advises that the sewing be done over a rubber bag which is introduced between the "presection" sutures and carefully inflated. He claims for this measure the attainment of a higher order of work.

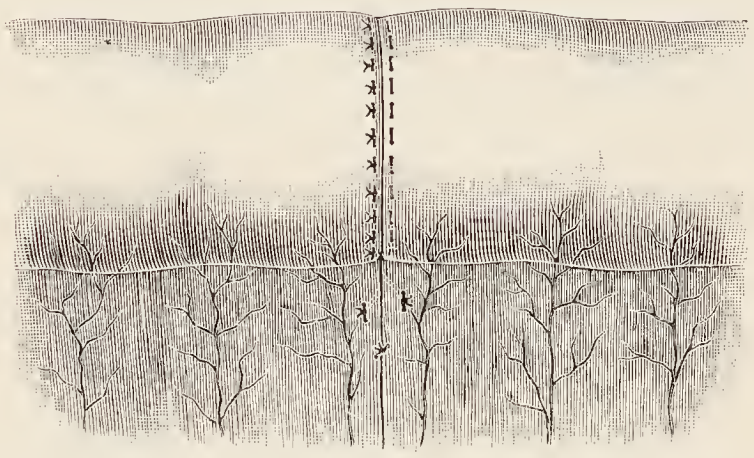


FIG. 876.—Resection of intestine, Halsted's method. Sutures tied.

Some years ago Treves devised a plan akin to this which he subsequently discarded. For further description, see Philadelphia Medical Journal, January 8, 1898.

*Harris's Method of Circular Enterorrhaphy.*—After resection of the desired portion and proper isolation and cleansing of the parts, Harris unites the divided ends in the following ingenious manner: Thread each of three needles with fine silk; remove the mucous membrane from the distal end of the gut for about three fifths of an inch with a sharp curette, being sure to destroy the glands; transfix at one side of the mesentery at the inner limit of denudation the denuded end of the bowel with a needle; cause the point of the needle to project from the caliber of the bowel a little beyond the free edge (Fig. 877); pick up transversely with the point of the needle (*a*), just to one side of the mesentery, close to the proximal end of the bowel, a portion of its wall; draw the needle back slightly, and turn the point backward and round so as to invaginate the upper into the lower end, to the point of the lower limit of denudation, then pinning it there by piercing transversely the coats of the distal end (*b*); repeat with the second needle the same action at the corresponding point of the opposite side (*c*). The portion opposite the mesenteric attachment is treated in a like manner with the third needle (*c*). The needles are then carried through, stitches tied, and permanent fixation is established (*d*). The exposed end of the bowel is then

sewed to the invaginated part with interrupted or continuous sewing, preferably the former, as less liability of contraction is encountered. This method of practice is well conceived, always available, can be quickly applied, and thus far the use has been followed by commendable results.

The use of the Murphy button, the bone bobbin, Senn's modification of Jobert's method (page 624 *et seq.*), or Maunsell's method, in lieu of the stereotyped end-to-end union by sewing, will, no doubt, be advantageous in many instances. The surgeon who makes a wise selection of one of many resources is possibly a safer custodian of human life than one who is wedded to a single expedient, even though it be of his own creation.

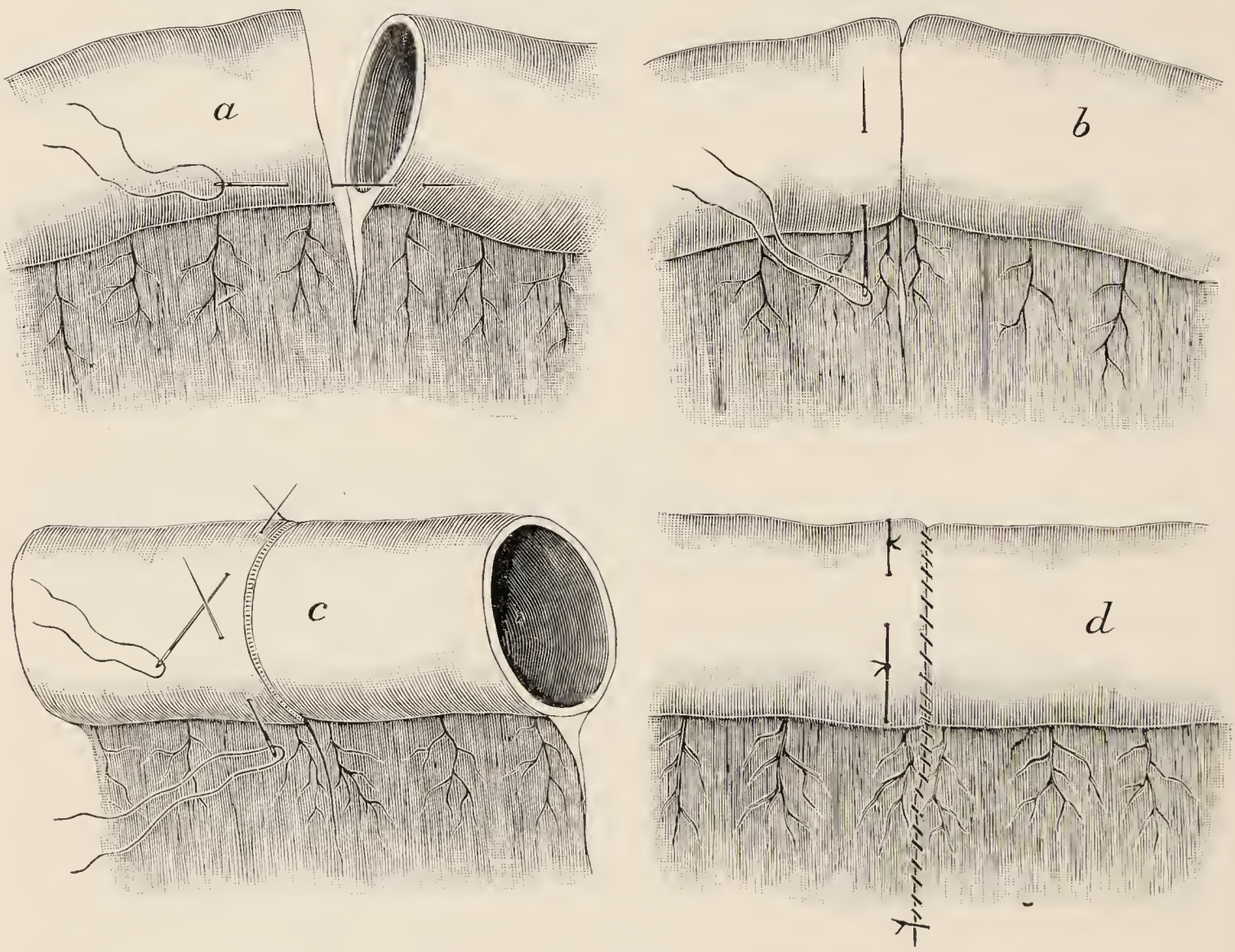



FIG. 877.—Circular enterorrhaphy, Harris's method.

*The Treatment of the Mesentery.*—Several methods of management of the mesentery are practiced: 1. Its division close to the bowel (Figs. 870 and 878), the folding in and union of the border by continuous sewing, and final closure, by sewing, of the opening left after uniting the intestinal extremities (Fig. 879). This method is one commonly practiced. It has been suggested that the redundant fold be turned to one side and fastened to the overlapped surface by a few silk sutures placed at the borders of the folded portion (*a*). 2. The removal of a triangular piece (Fig. 878, *b*) of the mesentery along with the portion of bowel and the stitching of the sides of the triangle to each other after sewing of the intestine (Fig. 880). Ordinarily, the sides of the triangle should not exceed the length of the base, but in operations for malignant disease of the intestine, for which this method is

especially adapted, attended with enlargement of the mesenteric glands, the extent of the outlines of the triangle may be governed by the extent of the

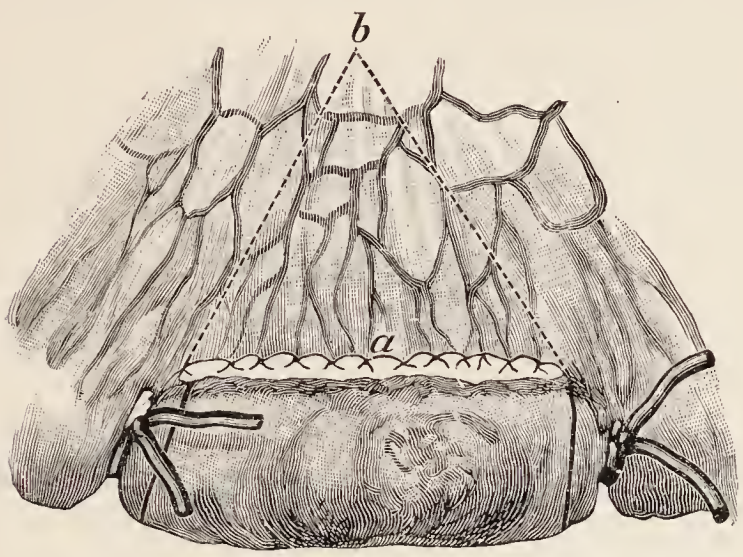



FIG. 878.

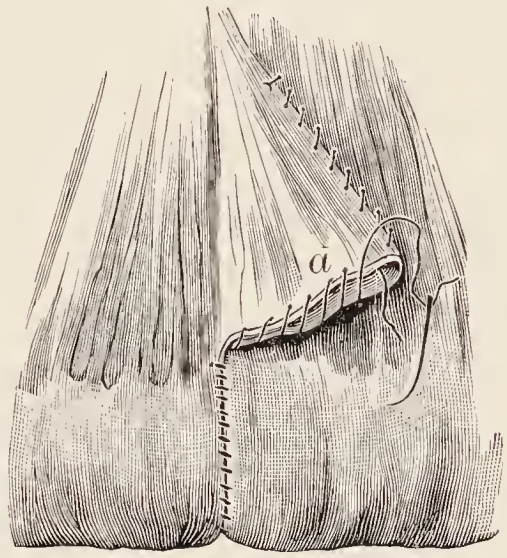



FIG. 879.

FIG. 878.—Resection of intestine, rubber bands applied. *a*. Mesentery ligatured, divided, and ready to turn aside (Fig. 879). *b*. V-shaped piece sometimes removed along with diseased area.

FIG. 879.—Resection of intestine, mesentery turned aside and borders united.

disease. This method leaves a smooth mesenteric surface, equally distributes intestinal movements, and is artistic in its finish. Still, it is thought to interfere with the vascular supply of the gut more than the preceding method. 3. The removal, along with the mesenteric border, of a strip of the serous coat of the intestine to be excised, about half an inch in width at either side of the mesenteric attachment, and closure of the resulting loop by sewing the same as in the first instance. This method is more ingenious than practical in its bearings. *Mitchell and Hunter* have devised an admirable stitch for the purpose of properly apposing the serous membrane to the uncovered part of the bowel at the base of the triangular space of the mesenteric attachment (Fig. 811), which at the same time adds much indeed to securing end-to-end union of the intestinal segments, thereby contributing greatly to the prevention of fæcal extravasation (Fig. 881).

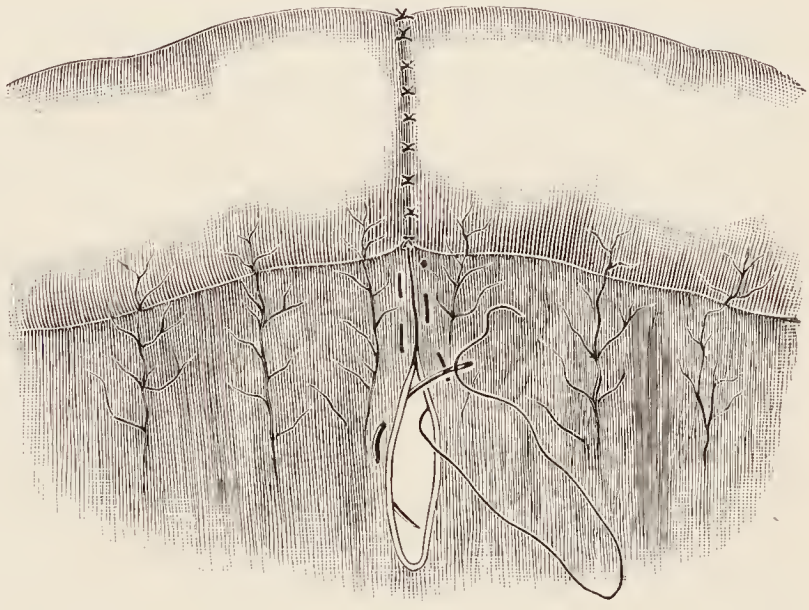


FIG. 880.—Resection of intestine. Union of borders of mesentery, Halsted's method.

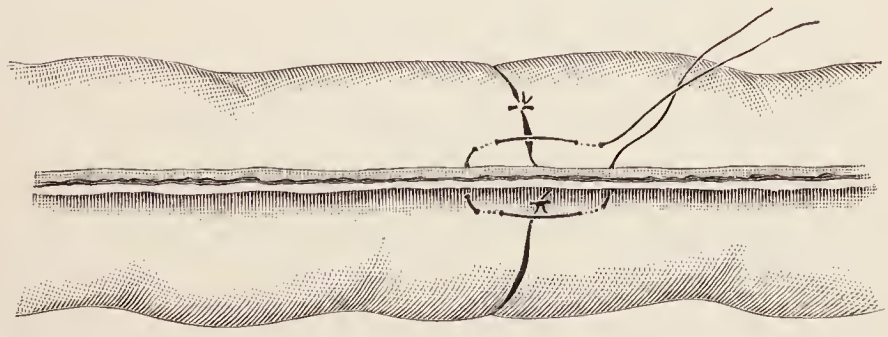


FIG. 881.—Mitchell and Hunter's suture for closure of attached border of mesentery.

*The Comments.*—Having completed the repair, the parts are carefully cleansed, returned to place, and the abdomen is closed. In some

instances, however, especially those in which for any reason the intestines are overdistended and oppose return and confinement in the abdomen, their contents should be discharged through one or more free incisions made at proper points in the longitudinal axis of the gut with a scalpel. These incisions can be easily closed by intestinal sewing. *McCosh* practices the injection of a solution of magnesium sulphate into the bowel, before closure of the incisions, with excellent results. Puncture of the intestine with a trocar is much less effective and quite as dangerous as the free incision. The spreading over the intestines and carrying beneath the borders of the wound an antiseptic towel, thereby forming an extemporized wall for the better return of the distended intestines to the abdominal cavity, is a practical measure highly commended by Murphy. The raising upward with traction sutures of the borders of the abdominal incision, thereby forming a funnel-like opening, is often soon rewarded by safe return of the distended bowels. The toilet, drainage, and closure of the abdominal cavity has been considered already under the head of Abdominal Section (page 612 *et seq.*).

*The Precautions.*—If the condition of the patient will permit, overdistention of the intestine from any cause should be relieved through an incision into the injured or diseased loop before resection is attempted, to avoid the greater chances of infection incident to the presence of the distention during repair, and also to secure the manipulative advantage of its absence at this time. The thorough elimination of the contents of a distended intestine by means of free irrigation of the cavity of the bowel with the hot saline solution is to be commended when practicable. Punctures made for the purpose of eliminating the gas from an overdistended intestine should be promptly closed with a suture—in fact, it is wise that the suture intended for this purpose be laid and pushed aside before the puncture is made, otherwise the paralyzed and overdistended state of the bowel wall will permit of precipitate escape of the contents. While the stereotyped abdominal incisions usually meet the demands of a case, still, it is important to remember that their extent and direction should conform to the demands of close inspection, prompt manipulation, and thorough elimination of infecting agents from the abdominal cavity. Flushing of the cavity for removal of blood clots, intestinal contents, etc., is commendable, except in the presence of established infection (page 612), then flushing is likely to cause diffusion instead of elimination of infecting agents. In any event, in established localized infection, thorough wiping away of this infection should precede general flushing.

*The Results.*—The modern methods of procedure in gunshot wounds of the abdomen result in about thirty per cent of recoveries, as compared with ninety-five per cent of deaths following the old non-operative, expectant method of treatment. Twenty per cent greater rate of recovery attends operations made during the first five hours of the injury than in those made from five to fifteen hours later. The results of intestinal resection for chronic causes—those not attended with the acute peritoneal infection that so often characterizes gunshot wounds—are better than for gunshot wounds alone, and may yet be much improved by earlier diagnosis and prompter operative effort.

**Gunshot Wounds of the Duodenum.**—Owing to the intimate relations to the duodenum of the stomach, pancreas, liver, etc., wounds of this bowel are often complicated with injury of the contiguous viscera, and therefore are correspondingly dangerous. Wounds of the duodenum alone are not so critical as those of the smaller intestines, since only the upper two or three inches of this portion of the bowel are intraperitoneal, the lower two thirds being covered only in front by this membrane. Wounds of the upper part of the duodenum are treated like those of other intestines similarly associated with peritonæum. A wound of the surface uncovered with peritonæum, as at the lower two thirds of the gut, should be closed with great care, scrupulous cleanliness, and re-enforced, if possible, by the utilization of adjacent serous covering so as to bring serous surfaces in contact the same as elsewhere in intestinal sewing. Wounds of the posterior surface of the lower two thirds of the duodenum are obviously retroperitoneal in character, and therefore less immediately dangerous than when communicating directly with the peritoneal cavity. However, repair here is difficult on account of the absence of serous surfaces; on the other hand, infection is greatly hindered for this reason, and drainage can be established posteriorly without involvement of the serous cavity in front, if necessary. Unless painstaking care be exercised, penetrating wounds of non-serous surfaces will escape notice.

**Gunshot Wounds of the Large Intestine.**—Wounds of the large intestine are less frequent and fatal than are those of the small. Wounds of the transverse colon are more fatal than those of the ascending and descending portions, because of its greater peritoneal environment. Wounds of the large intestine can be divided practically into those involving the serous and those involving the non-serous surfaces of the gut. The former are closed the same as in the small intestine; the latter in the careful manner that characterizes the sewing of non-serous surfaces of other parts of the intestinal canal (page 653). The introduction into the bowel of ordinary air by means of an old-fashioned bellows, or by blowing, even, through a rubber tube with one end in the rectum, can be employed for detection of obscure wounds of the colon in lieu of insufflation with hydrogen gas. In uncomplicated wounds of the large intestine an incision in the median line is usually not necessary. A vertical one at the linea semilunaris, supplemented when necessary by another carried outward and downward toward the spine, affords ample opportunity for examination and repair.

*The Results.*—The rate of recovery after operation for gunshot wounds of the large intestine exceeds that of the small by three or four per cent.

*The after-treatment* in gunshot wounds is not especially dissimilar from that for other grave intestinal operations. The ice-water coil can be applied to the abdomen with advantage in these cases.

**Stab Wounds of the Abdomen.**—In stab wounds of the abdomen one of the important duties is to determine if the peritoneal cavity has been entered, which is accomplished in the same manner as in gunshot wounds. Not infrequently the escape through the wound of omentum or intestine settles the fact at once. In prospectively estimating the extent of the injury, the nature and characteristics of the penetrating agent, together with the direc-

tion and force of the blow, must be determined when possible. The ascertainment of these facts need not take additional time, since it can be rapidly gained during the preparatory steps for the operation, which steps are frequently made the more comprehensive by reason of the knowledge thus gained. The primary incision is commonly made at the seat of the injury down to the point of penetration. All hæmorrhage is arrested, the abdomen entered, retraction sutures are introduced, and the borders of the wound drawn apart with as little disturbance of the underlying structures as possible; the omentum, intestines, and mesentery respectively are carefully examined, bleeding points caught, and wounds closed temporarily, as soon as found; blood, infecting agents, and foreign bodies are carefully wiped away, aided by gentle flushing with a hot saline solution, in the manner already described in the treatment of gunshot wounds of the abdomen. Severe hæmorrhage is arrested by direct pressure with sponges, or digital pressure on the aorta; the bleeding points are caught and tied with silk. Wounds of other viscera are looked for, if contiguity of the injury or other circumstances of the case suggest the possibility of such a complication. In fact, but few practical differences arise in the treatment of gunshot and stab wounds of the abdomen. The methods of repair are the same in each, but of the simpler types in the latter, owing to the simpler nature of the injury. Punctured wounds of the mesenteric borders of the intestine are united the same as those of the convex surface, unless they be ragged; then the treatment for gunshot wounds at this situation is practiced. The antiseptic care during the operation is in all respects similar to that for gunshot wounds.

*The Comments.*—A prompt examination to determine the presence of peritoneal penetration should be made, for no harm can follow if penetration have not taken place, and much good may come with the knowledge of its occurrence. The escape from injury of the intestines in stab wounds of the abdominal cavity is, indeed, often marvelous. This good fortune is due almost entirely to the comparative slowness of the entry of the penetrating agent, and its dullness, and also to the mobility of the intestine, especially when empty. The wounds inflicted with broad-bladed or double-edged weapons are especially dangerous, since the cut in the intestine is large, and the escape of intestinal contents and the loss of blood are proportionately great. Profuse and persistent bleeding often attends such wounds as these, and the efforts to arrest hæmorrhage should be conducted carefully to avoid unnecessary spreading of effused intestinal contents.

*The Results.*—The percentage of recoveries is estimated differently by different authors; from 13 (Dalton) to 39.24 (Morton).

**Contused Wounds of the Abdomen.**—Contused wounds of the abdomen are often complicated with contusions and lacerations of the intestine. The jejunum suffers most frequently, because of its relations to the spinal column and its comparative immobility. The ileum is next in order of frequency. The duodenum suffers comparatively often when its brevity and retired position are considered. However, its fixity and relation to the spine predispose greatly to injury. The colon as a whole is well protected because of its comparatively secluded position. The ruptures vary in num-

ber and extent. In ninety per cent of the cases they are single; in twenty per cent they involve almost, and occasionally the entire width of the bowel (Curtis), the usual dimension being about an inch in length, therefore fæcal extravasation is a common result. Laceration or contusion of the mesentery is a formidable complication, as it happens in about sixteen per cent of the cases, and eighty per cent of these die from hæmorrhage. Inasmuch as the majority of patients die in forty-eight hours after the time of the injury prompt operative interference is demanded. After shock has subsided and thorough aseptic preparation for operation is secured, a median incision four inches in length is made, retraction sutures are introduced, and the borders of the incision drawn apart sufficiently to permit of the inspection of the exposed abdominal contents. If needful, this incision can be enlarged upward or downward sufficiently to allow of a completer scrutiny. Gas, intestinal contents, and blood may be noted in the field of observation. If hæmorrhage be pronounced, the bleeding points must be sought for and closed at once, and all intestinal openings temporarily closed with clamps as they appear during the search. Digital compression of the aorta and direct sponge pressure of the bleeding field should be practiced if necessary, to arrest the outpour of blood. Finding the location of the bleeding site will often be facilitated by removal of the intestines from the abdominal cavity, in which case they should be surrounded by rubber tissue and supplemented by aseptic gauze saturated with the hot saline solution, and kept thus until returned to their proper place. Infecting agents are wiped away with soft, moist, hot aseptic sponges, or washed out with a saline solution, the use of which often stimulates the flagging forces of the patient, and enables the surgeon the better to accomplish his purposes. If contamination of the peritonæum have happened, rapid and copious flushing and cleansing of the peritoneal cavity and the intestines with a hot saline solution should be practiced before their return. This course hastens the final toilet of the cavity, makes it the more thorough, and also balances, in part, at least, by stimulation the ill effects caused by the eventration. However, repair of the defects during eventration should be avoided when practicable, as this course commonly increases the gravity of the case. After the return of the intestines, the repair of lacerated and contused wounds of the convex border of the bowel is made by simple inversion, or limited excision with or without "elbowing" (Fig. 866) as the extent of the injury may require. Wounds of the mesenteric border of the intestine and of the mesentery itself, that compromise the arterial supply of the gut, are followed by gangrene, and therefore enterectomy should be practiced according to the principles and after the manner employed in gunshot wounds. It is frequently necessary to abbreviate remedial effort by the substitution of a fæcal fistula (enterostomy) for other methods of procedure, in order to avoid imminent danger of death of the patient, applying the final remedy later. However, if the duodenum or the upper part of the jejunum be involved, the practice of enterostomy is soon followed by starvation and death, hence the defect should be promptly remedied. Therefore, the ileum and lower part of the jejunum are the parts best adapted for the establishment of a fæcal fistula.

After replacement of the intestines, the necessary measures of repair are performed with the aseptic technique heretofore advised for the purpose (page 653). The final peritoneal toilet, drainage, and closure of the abdomen differ in no essential respects from that before described (page 612). Contused points of intestine attended with extravasation within the tissue of the gut should be turned in when practicable, and the borders united by sewing; the borders of gaps in the serous covering should be drawn together by fine silk sutures.

*The Results.*—The results are doubtful at the best, and unfavorable without early action, and even then it is sometimes wiser to make a temporary fistula low down than attempt the performance of a radical procedure.

In 95 cases the mortality from operation was 47 per cent. In those for horse-kick alone about 70 per cent. In 54 cases, those operated on before the twentieth hour, 80 per cent recovered; after this time, but 26 per cent were successful. The average duration of operative interference was an hour in the successful cases, and an hour and twenty-five minutes in the unsuccessful. An occasional death from errors in technique happened. Cases of injury of other structures than the intestines and their associated vessels are excluded from this list. Temporary enterostomy was practiced in four cases, three of which recovered.

**Abdominal Section in Intestinal Obstruction.**—It is unusual, indeed, that the services of a surgeon are called for in these cases in time to afford a fair measure of success to the patient. The uncertainty in diagnosis and the tendency to procrastination rob the patient too often of the benefits of surgical resources. The potent influences of pain, vomiting, loss of sleep, lack of nutrition, and the septic effects of intestinal accumulation and distention, are usually indelibly stamped on the features and vital forces of the patient at the time the surgeon is called. Since it is the duty of the surgeon to save life irrespective of the completeness of a surgical procedure, frequently he must decide between the adoption of temporary enterostomy, with possible recovery, and completed details with probable death.

**Enterostomy.**—Enterostomy consists in the making of an opening into the small intestine and the temporary or permanent attachment of its borders to those of a corresponding opening in the abdominal wall, for the purpose of relieving the intestinal distention due to obstruction or for the nourishment of the patient. Enterostomy is usually performed at the right side, but it may be done at the median line or the left side. It is established in the median line when it is found to be impracticable to overcome the difficulty in the intestine for which the incision was made and when to establish the opening elsewhere would be inexpedient. The opening under these circumstances becomes an artificial anus.

*Kocher's Method* (*Fæcal Fistula*).—Make an incision at the outer side of the epigastric artery two inches and a half in length, parallel with and an inch and a half above Poupart's ligament, down upon the peritonæum. Arrest hæmorrhage and make an opening in the peritonæum an inch and a half in length; draw carefully into the opening the presenting loop of *distended* intestine sufficiently to allow only the convex border of the gut to

project above the surface of the abdomen; pass a silkworm-gut suture at each end of the wound through all of the tissues at a little distance from the borders, including the serous covering of the gut, thus fixing the loop of intestine and shortening the primary incision. Sutures may be passed similarly at either side of the wound, if advisable. Stitch the wall of the bowel to the divided peritonæum with a continuous silk suture (Fig. 882); supplement this row with a superficial one of catgut, uniting the integument with the serous and muscular walls of the bowel, carefully avoiding penetration of the gut; smear the wound freely with iodoformized vaseline to prevent the contact of intestinal contents with the raw surfaces; puncture the protruding loop at the convex border with the point of a scalpel, and direct the escaping substances aside with rubber tissue, or oiled silk, as fast as they escape. No effort should be made to hasten the discharge, nor should the intestinal canal be flushed. After the vigor of the flow has ceased, wipe the integument dry, smear it with vaseline, cover the wound with an abundance of absorbent cotton or with oakum, which dressing confine in place loosely and change when soiled. If the case be very urgent, the supplementary row of sutures can be omitted. If delay be permissible, the intestine need not be opened so soon, two or three days being granted to first secure firm adhesion of the gut to the borders of the wound. The median incision of an exploratory operation can be utilized in forming an artificial anus, in case it be necessary to desist from further radical procedure. This incision offers the advantages of a definite diagnosis, and the location of the fæcal fistula close to the point of obstruction, which are important desiderata if no further efforts at relief are contemplated.

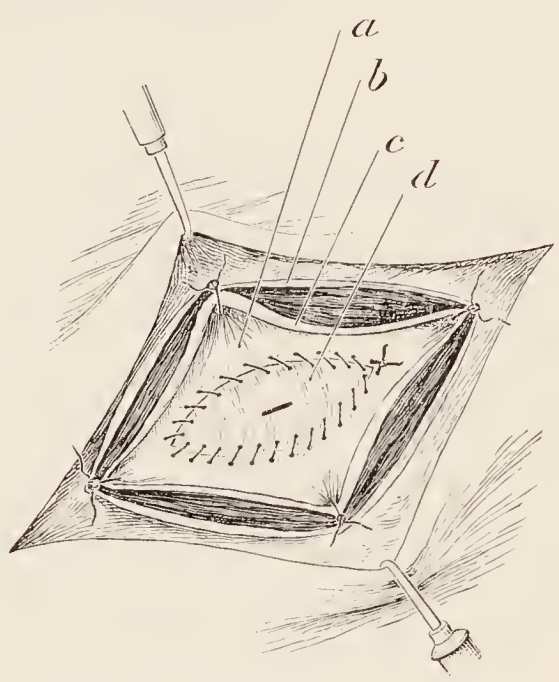



FIG. 882.—Enterostomy, Kocher's method. *a*. Parietal peritonæum. *b*. Aponeurosis of external oblique m. *c*. Transversalis fascia. *d*. Intestine.

*The Precautions.*—The division of the epigastric artery will be an embarrassing complication. However, as it runs upward and inward from behind the middle of Poupart's ligament, it can be easily avoided by cutting outside of the latter point. Care should be taken to obviate a twist in the presenting loop of intestine for self-evident reasons. It is likewise apparent that the opening of a collapsed intestine will afford no relief. Scrupulous attention should be given to the condition of the patient during operation by one assigned for that purpose, otherwise an unexpected sudden demise of the patient will deepen the responsibility for the case. If the intestine be much distended the walls may be correspondingly thinned, and therefore readily punctured in sewing, causing infection of the deep tissues of the wound and perhaps of the peritoneal cavity itself.

*The Remarks.*—The opening in the gut should be as small as practicable, to avoid undue prolapse of the mucous lining of the bowel, and to limit the

area of subsequent repair. The length of the primary incision will be regulated principally by the thickness of the abdominal walls. If the element of time be unimportant, the borders of the divided peritonæum can be first stitched to those of the integument, thus lining the opening with serous membrane, thereby providing a firmer and securer union between the intestine and the borders of the opening.

*The Results.*—Not infrequently the establishment of a fæcal fistula cures entirely the original infliction, and later the fæces flow uninterruptedly through the normal channel. The following statistics compiled by Curtis, bearing on the results of enterostomy in acute intestinal obstruction, emphasize the importance of the procedure in no uncertain terms. In sixty-two cases 46 were relieved, 6 unrelieved, and the outcome not stated in 10; 51.7 per cent recovered, and in 60 per cent of the recoveries the fæcal flow resumed the natural channel. Forty-eight per cent died. According to Curtis, the rate of mortality of abdominal section in this class of cases is twenty per cent greater than that of enterostomy, and the benefits of the former do not compensate for greater death rate. Some patients who are unable to endure enterostomy, which can readily be performed under cocain anæsthesia, can not be expected to survive the operation of abdominal section. Therefore, a patient rescued at the outset by the safer plan has a subsequent opportunity of cure by the graver method.

**The Making of an Artificial Anus** (Kocher) in the small intestine differs in an important degree from the establishment of a fæcal fistula at the same situation. The former is a permanent affair and includes the entire width of the intestine, so that all the fæcal matter passes through the opening. It may be established in the groin or in the median line. Up to the time of incision of the peritonæum there is no practical difference in the technique of the two operations. The peritoneal opening is made smaller in artificial anus, the loop of intestine is drawn completely out of the wound, and the proximal extremity placed uppermost before the loop is stitched to the borders of the peritoneal incision with the continuous silk suture (Fig. 883). The proximal part of the loop is given the most room, and is so arranged as to press on the distal part. Sew the parts and smear them with vaseline, as in enterostomy; open the intestine sufficiently to cause free and complete escape of the contents; cleanse the wound and remove the triangular portion indicated in the illustration. The after-attention is all a matter of cleanliness and nutrition.

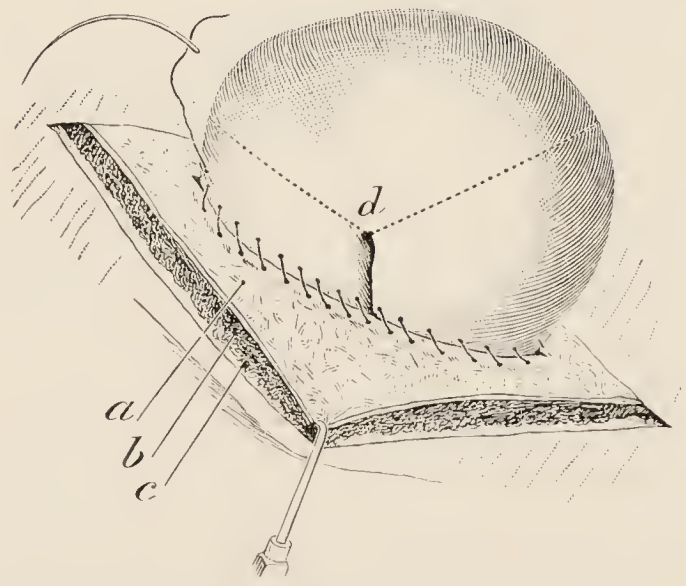



FIG. 883.—Enterostomy, Kocher's method. *a*. Parietal peritonæum. *b*. Abdominal muscles. *c*. Integument. *d*. Diverging lines of division.

*The Remarks.*—It is proper to recall under this heading the fact that a permanent establishment of the intestine in relation to the external wound requires that the obstruction be low down, and that the opening be made as

near to it as possible. Innutrition and even starvation will ensue if an artificial anus be located too near the stomach. If time will permit, the operation can be divided into steps, the final one—the opening of the anus—being deferred until after adhesions have taken place. If the loop with-

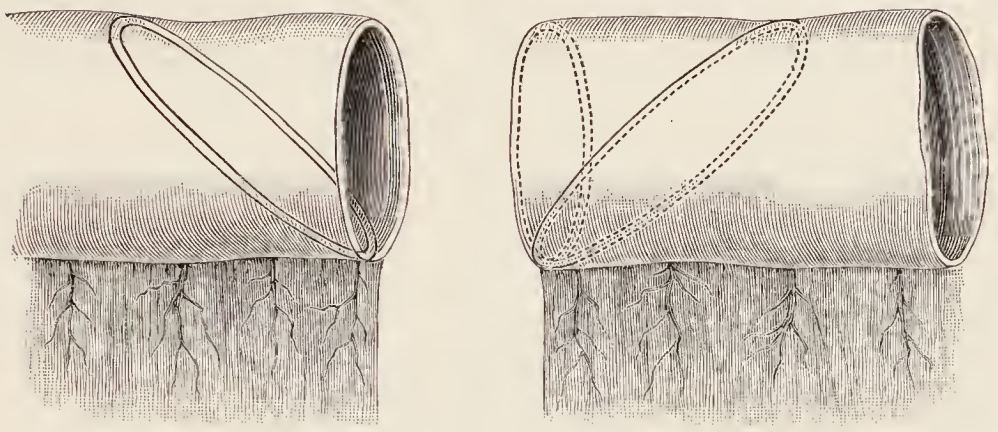


Fig. 884.—Elbowing in circular enterorrhaphy, Jeannel's method.

drawn be distended it should be emptied into a contiguous loop and clamped to prevent return of the contents, thus avoiding the danger of penetration of the gut in sewing, due to the thinning of the wall dependent on over-distention. The abdominal-wall sutures close to the protruding parts should be clamped until these parts are properly adjusted and then tied. The intestine may be fixed in place in this instance with a glass rod (Fig. 890, *k*), or by a similar agent, the same as in colostomy, or sutures only may be employed for the purpose. The smaller the protrusion is, consistent with utility, the less is the danger from contamination and of annoyance from friction. Before opening the gut it is often expedient to introduce at either side of the proposed site of entrance traction sutures, thus securing better control of the part during evacuation. The trocar and cannula may be employed, or the glass tubes of Paul (Fig. 892), the same as in colostomy.

**Enteroplasty.**—Enteroplasty is an operation commonly applied to the surgical treatment of the denser tissues of the intestines, without resection, for the purpose of repairing defects in the caliber of the gut (Figs. 863 and 865), as in pyloroplasty (page 995 *et seq.*) by the various methods of elbowing (Fig. 866), etc. *Jeannel* elbows the intestine in performing circular enterorrhaphy by making oblique section of the ends (Fig. 884), his reason therefor being to allow a larger caliber at the seat of union (Fig. 885), to offset the subsequent narrowing from cicatricial contraction. The dangers from kinking are greater in this than in the preceding method

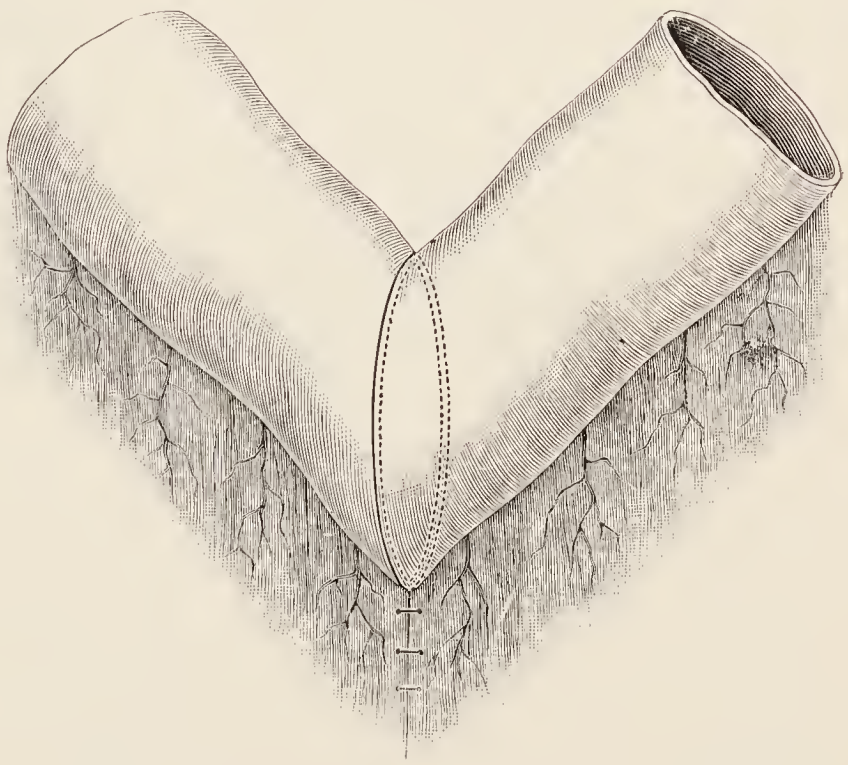


Fig. 885.—Elbowing in circular enterorrhaphy, borders united, Jeannel's method.

(Fig. 866); and, besides, it is less expeditious and in nowise the better plan.

*Chaput* elbows the intestine by uniting the transversely severed ends, followed by slitting the bowel opposite the mesentery for an inch or more, trimming the corners, and sewing together the borders (Fig. 886). This method has no practical advantages over the preceding. Chaput's method of circular enterorrhaphy with oblique incision without elbowing, is accomplished by cutting the ends transversely in the long axis, so as to form an

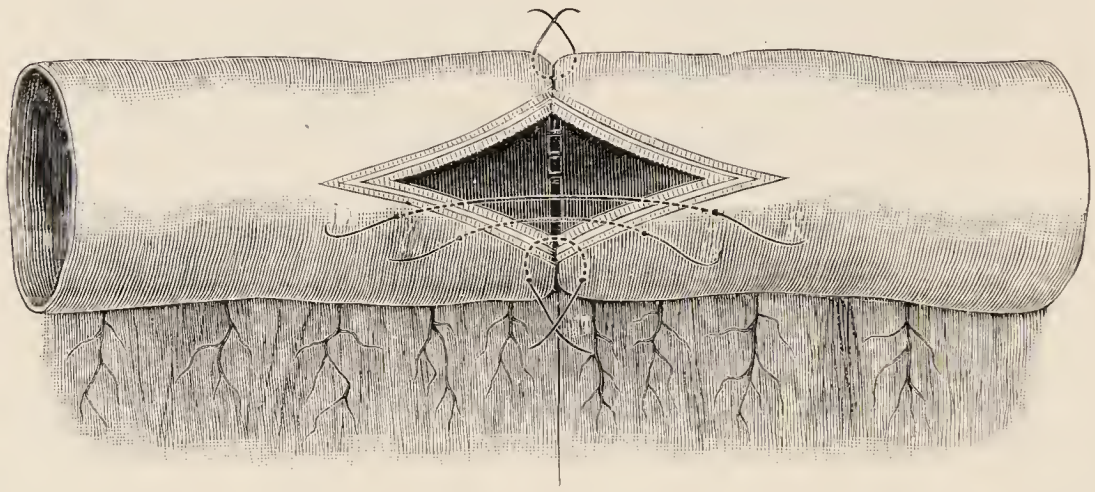


Fig. 886. — Elbowing by circular enterorrhaphy and longitudinal slitting, Chaput's method.

equal ellipse at opposite sides of either extremity of the intestine (Fig. 887). The mesenteric involvement in these incisions is not regarded as significant. The union of the ends secures a long oblique line of coaptation and leaves the intestine straight. We are disposed to extend the application of the term enteroplasty, for the sake of convenience, at least, to the repair of serous surfaces of the intestines by means of omental grafting, and the transference of serous membranes by sliding, jumping, etc., as may be required in connection with repair of a wounded, non-serous intestinal surface.

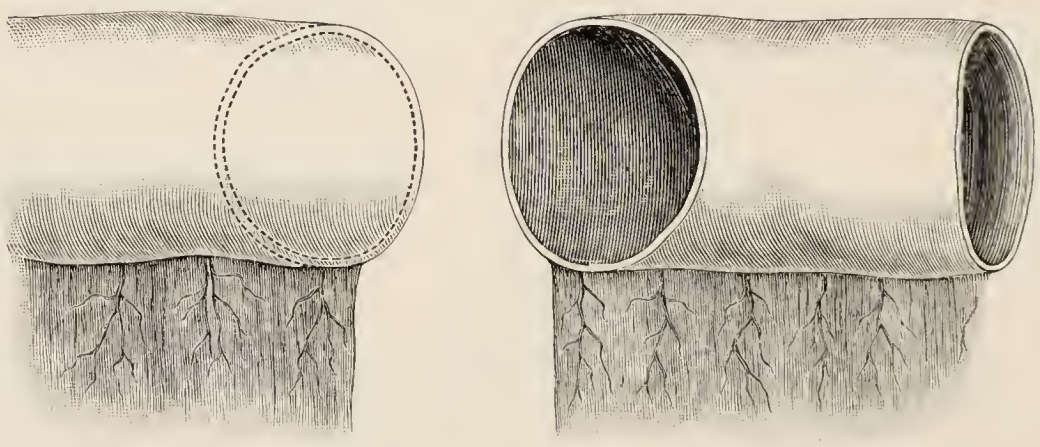


Fig. 887.—Circular enterorrhaphy, oblique section, no elbowing.

*Omental Grafting* was set forth by Senn, and is advised for the repair of the peritoneal defects incident to the union of serous surfaces by sewing. Omental grafting is practiced in the following manner: Grafts of proper size and shape to meet the indication are cut from the omentum and placed at once in the hot saline solution. Slight scarification for an inch or so at both sides of the part to be repaired is quickly practiced; take the graft from the solution, place it between two layers of aseptic gauze to remove

superfluous fluid, place it carefully in position over the serous defect and fix it there with a few fine catgut sutures (Fig. 888). In the course of a few hours the graft becomes quite firmly adherent. Omental grafting is advised for the repair of other peritoneal defects than those the result of sewing, to obviate adhesion of injured serous surfaces. The objection is made to this kind of grafting that the grafts contract and interfere with the outline and caliber of the lumen of the intestine.

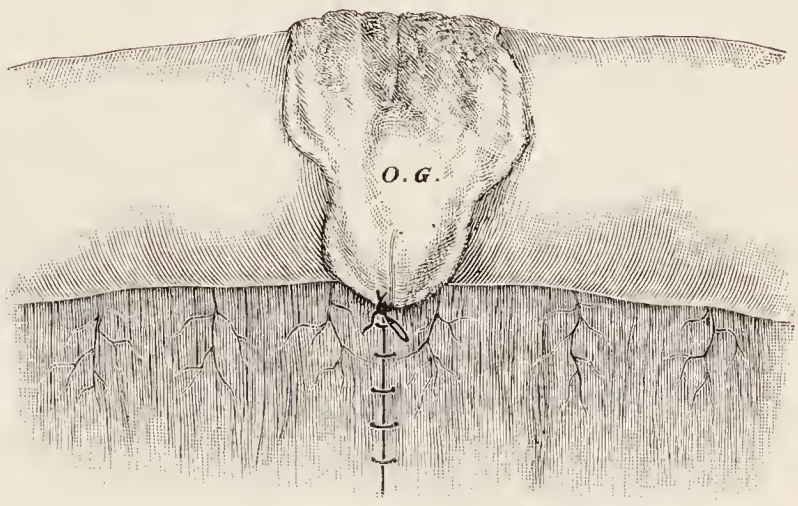



FIG. 888.—Omental graft (*O. G.*), Senn's method.

**Colostomy.**—The term colostomy is applied to the establishment of an artificial anus in the colon, but for the sake of simplicity it should include also the cæcum and sigmoid flexure. The object of the operation is for the relief of obstruction of the large intestine, and to divert the fæcal current from contact with distal ulcerating and sinous surfaces. The author has once performed colostomy for the relief of otherwise inoperable prolapse of the rectum with marked palliative results. *There are two common varieties of colostomy*, inguinal and lumbar, the former being intraperitoneal and the latter usually extraperitoneal. Inguinal colostomy may relate to the cæcum or sigmoid flexure according to the side attacked. Lumbar colostomy is applicable to either side, but is commonly effected at the left (Fig. 889).

**Iliac Colostomy** (Littré).—Formerly the lumbar incision was more commonly employed than this one, but now it is rarely done except in those cases in which malignant involvement or binding down of the sigmoid flexure makes it impracticable to open or reach the latter, and also in those cases attended with great distention of the gut and other manifestations calling for prompt, imperative action, as sometimes happens. An artificial anus at the left iliac fossa is more conveniently situated, the steps of the operation are less perplexing, and the sequels less significant than in lumbar colostomy, except as to the danger of peritonitis, and even this is insignificant in the presence of modern aseptic methods. Moreover, the operation is easier for the surgeon and safer for the patient, so far as anæsthesia is concerned. A flaccid colon in a fleshy patient renders the lumbar operation exceedingly difficult. However, careless technique in the inguinal operation may cause fatal peritonitis and also annoying prolapse.

*The Operation.*—Place the patient on the back with the limbs extended; make an incision two inches and a half in length with the center corresponding to the anterior superior spinous process of the ilium at a point an inch and a half inside this process (Fig. 891) in the course of the fibers of the external oblique; separate and draw apart the fibers of the external oblique and in turn those of each succeeding muscle as soon as it appears, until the transversalis fascia is reached, which, along with the peritonæum, is divided for about two inches in the line of separation of the transversalis

fibers; introduce a strong retraction suture through all of the tissues at each side of the wound, in order to draw the borders of the wound wide apart and prevent the stripping up of the peritonæum incident to manipulation; intro-




FIG. 889.—Instruments employed in colostomy, etc.

*a*. Scalpels and bistouries. *b*. Scissors. *c*. Forcipressure. *d*. Needles and traction loops. *e*. Ligatures. *f*. Needle-holder. *g*. Sponge-holder. *h*. Blunt retractors. *i*. Blunt hook. *k*. Glass rod and iodoform gauze for support of intestine. *l*. Thumb forceps. Tenacula, mouse-tooth forceps, sponges, wipers, large rubber-tube trocar and cannula, small basin, rubber tissue, and an abundance of gauze, etc., should be provided.

duce the index finger into the abdominal cavity and carefully examine the contiguous parts for the presence of disease manifestations; withdraw the finger, bringing along with it a loop of the sigmoid flexure; make downward

traction on the upper limb of the loop and thus pull the intestine from above, returning it as fast below, until the mesocolon prevents further escape; pull out the sigmoid loop sufficiently to expose the attachment of its mesentery; open the mesentery at the point of attachment near to the middle of the loop and thrust through the opening a sterilized glass (Fig. 890) or rubber rod, or roll of iodoform gauze, of sufficient length to rest readily at either side of the wound, on the surface of the abdomen; lift the intestine upward a little with the rod or gauze and unite the portions of the loop immediately above and below it with each other by two sutures passed at either side through the sero-muscular walls of the intestine and tied so as to form a proper spur (Fig. 891); unite the protrusion to the borders of the abdominal opening by interrupted silk sutures passed with a curved needle through only the musculo-peritoneal borders of the wound and the sero-muscular coats of the intestine respectively; cut the ends of the sutures long, treat the intestine with sterilized vaseline and the remaining portion of the wound with iodoform gauze. Cover the whole with aseptic gauze held in place by an ordinary binder. At the end of three days, union of the surfaces will have occurred, when, according to the demands of the case, one of two courses can be pursued, the establishment either of a permanent artificial anus or of a temporary fæcal fistula. If an artificial anus be the desideratum, seize the loop of intestine with mouse-toothed forceps, and with scissors remove the wall of the bowel to within half an inch of the line of suturing, arresting the bleeding points as they arise; divide the bowel through transversely in the line of the rod, permitting the lower segment to retract; remove the sutures first applied and stitch the end of the upper segment to the integumentary borders of the wound. If only a temporary fæcal fistula is desired, make a short, longitudinal incision at the convex surface of the loop, remove the primary sutures, and join the borders of the intestinal incision at three or four points with the integumentary borders of the wound. The rod is removed in a week or ten days and the sutures taken away. The bowel then falls downward into place, retraction obliterates the spur, and more or less of the fæcal flow resumes the natural channel, and thus it continues until cured by natural or artificial means.

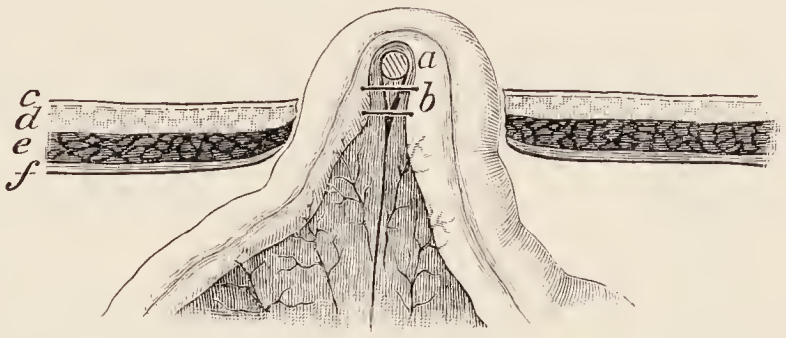



Fig. 890.—Iliac colostomy, rod and sutures placed to form spur. *a*. Glass rod. *b*. Sero-muscular sutures. *c*. Skin. *d*. Fasciæ. *e*. Muscles. *f*. Fasciæ and peritonæum.



Fig. 891.—Iliac colostomy, bowel raised up and supported by a firm roll of iodoform gauze (Fig. 963).

*The Remarks.*—Instead of the glass rod or iodoform gauze to hold the intestine in place, the mesocolon can be sewed to the borders of the wound. After closure of the opening of the distal part of the bowel, *Paul* advises the introduction into the proximal part of a glass tube an inch in diameter (Fig. 892), to which is connected a rubber tube to carry away the fæcal discharge. Later, the superfluous extremity of the bowel is cut off. The stitching of the parietal peritonæum to the integumentary border of the wound, to secure prompt union with the gut, is practiced infrequently now, because the repair is regarded less secure than that from the contact of the cut borders of the wound with the bowel. Nevertheless, if the bowel be fastened as directed, the prompter union may be secured without special danger of subsequent prolapse. If the sigmoid flexure evade detection, the introduction of water or air into the rectum, with the finger at the brim of the pelvis, will soon reveal the whereabouts of the bowel, and if it pass to the opposite side the site of the operation should be changed at once.

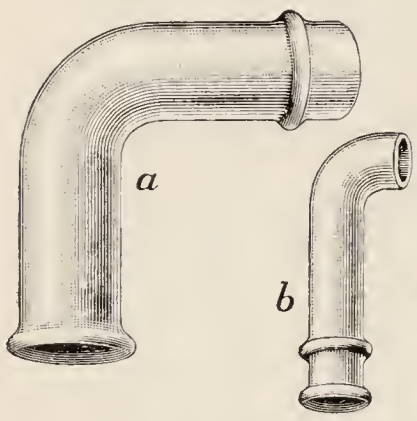



FIG. 892.—Paul's tubes for use in colostomy. *a*. For large intestine. *b*. For small intestine.

*The Precautions.*—Pull down as much of the sigmoid flexure as practicable before uniting it with the wound, to limit the subsequent prolapse of mucous membrane. If, as sometimes happens, the presenting loop be twisted at this time, the direction of the line of traction will be reversed, with obvious results. The opening in the distal extremity of the divided gut should not be permitted to close when frequent cleansing of this portion of intestine is desirable, as in connection with malignant disease. In fact, the patency should be maintained in these cases by the introduction through the opening of a large rubber tube or a plug of gauze. If entrance of fæcal matter to the lower segment of the bowel be not prevented primarily by the inversion and closure of the borders of the opening (Senn), the influence of subsequent cicatrization may close it with or without the aid of supplementary procedure. Much has been said from time to time regarding the practice of dividing the bowel entirely, closing the lower end, and dropping into the peritoneal cavity. At the first blush this course seems practicable, since it at once prevents the entrance thereto of fæcal matter, but when it is recalled that a long, twisted mesentery may again—as often before—cause the upper to be mistaken for the lower part—unless the latter have been explored from below—that the lower may contain already much fæcal matter; that division of the gut increases the difficulty of operation, and exposes to greater danger of infection; and, finally, that the formation of a pronounced spur will prevent fæcal flow into the distant part, which still remains patent for cleansing purposes, it will be seen little remains to be said in support of the practice.

*The Sequels.*—Fæcal incontinence should be treated with compresses, or even a hernial truss; excoriations, with vaseline, oxide of zinc, etc.; prolapse of mucous membrane, by excision and reunion to the borders of the wound.

*The Results.*—The rate of mortality from the operation alone is about two per cent.

**Bodine's Method.**—The steps of this commendable procedure need not differ in any essential regard from those of the preceding until after division of the peritonæum. The divided borders of this membrane are then stitched to those of the integument. A loop of intestine about twelve inches in length is drawn out through the opening, and carefully protected with gauze; the surfaces of the intestine are properly apposed and held in place by two rows of continuous silk sutures, six inches in length, placed one inch apart, one row behind the other in front of the loop (Fig. 893). The loop is then pressed back into the peritoneal cavity until the point at which the opening is to be made is nearly on a level (*a*) with the integument, when, if the gut is to be opened at once, it is joined to the margin of the abdominal wound by a continuous silk suture; if not until twenty-four hours later, catgut may be used instead. Any important structural change of the wall of the intestine at this situation should be made to appear at the apex of the loop, and the intestinal surfaces are then so united for about six inches, that thereafter the morbid process can be removed, leaving the spur properly

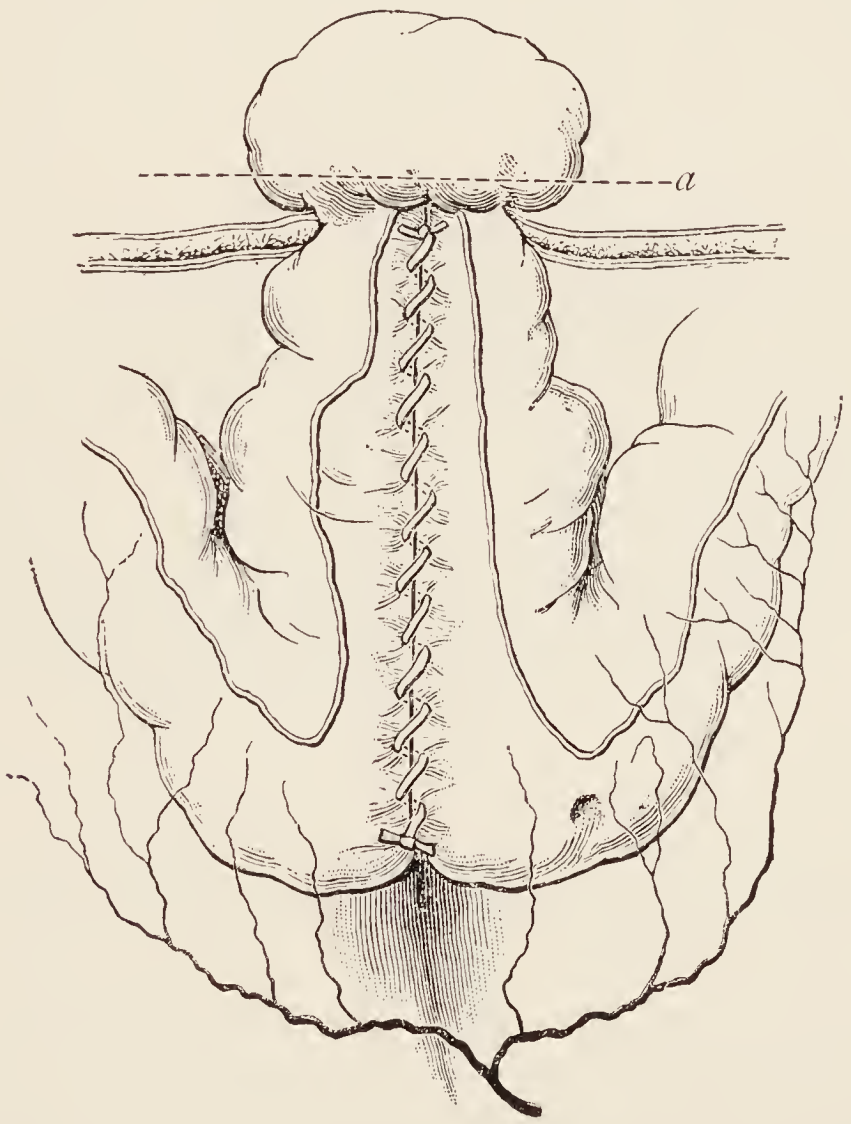



FIG. 893.—Bodine's operation of colostomy by lateral approximation, with final restoration of the continuity of the canal. The sewing of one side of the loop is shown, with the bowel pushed back and ready for stitching to the abdominal wound. The lesion remains without, and the dotted line (*a*) indicates where it is to be cut off.

located. If the fistula is to be permanent the mesenteric attachment may be located midway between the two rows of sutures.

*If subsequent repair* of the intestine be contemplated, the approximation sutures should be so placed that one row will be close to and parallel with

the mesenteric attachment, and the deepest part of the approximation should be fortified by interrupted and continuous sutures to secure that part against all danger of leakage after division of the septum.

*The cure of a fæcal fistula* established by this method of practice is singularly simple, safe, and effective. For this purpose the septum is divided in the median line with Grant's enterotome (Fig. 894), or with ordinary sharp, blunt-pointed scissors, carefully guided by the finger. The external opening is then closed in the usual manner. In dividing the septum care should be taken not to injure the mesenteric vessels lying near its border, nor to sever the lower limits of the approximation. In the instance of

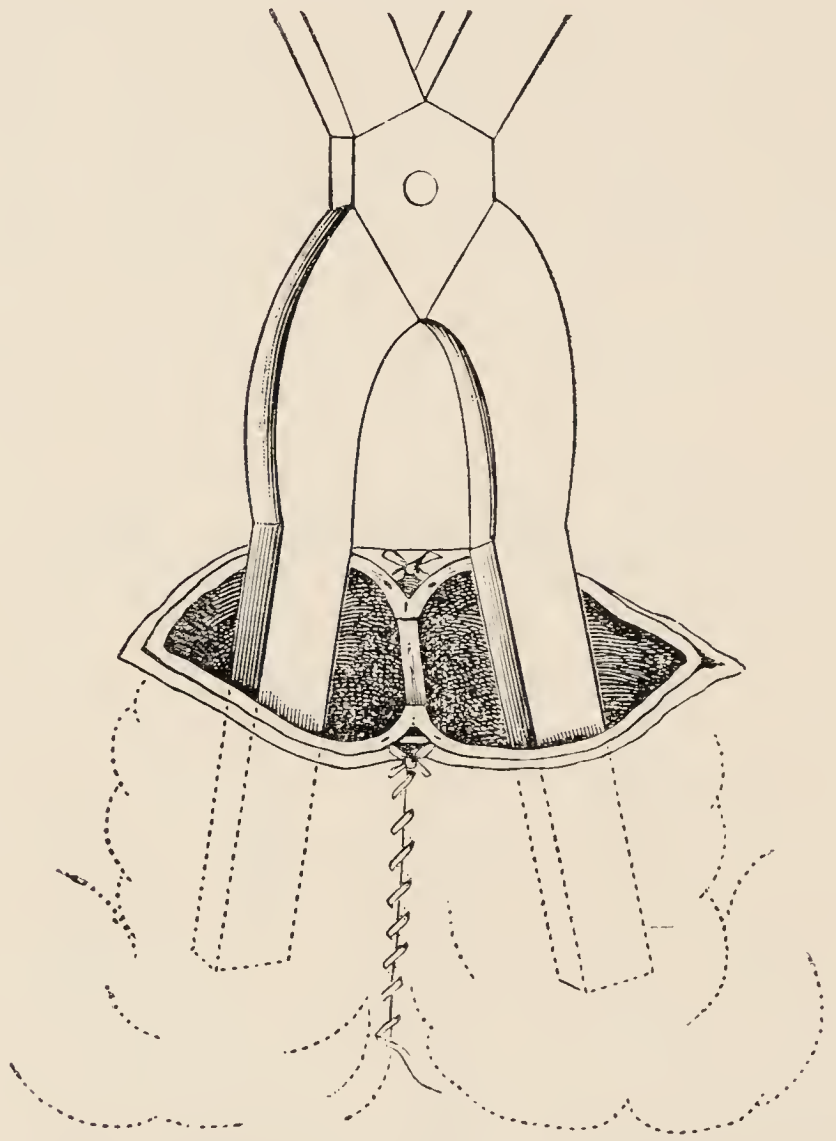


Fig. 894.—Bodine's operation of colostomy, showing division of the septum with Grant's enterotome in restoring the fæcal current. In permanent colostomy this septum remains as a rigid and effective spur.

either a temporary or permanent fistula, delayed opening of the gut can be readily accomplished under localized cocain anæsthesia.

**Cripps's Method.**—The technique of Cripps's method differs from that of the preceding in some important respects. Cripps united the borders of the divided peritonæum with corresponding borders of the integument with several stitches (*b*, *b*), thus lining the opening with a serous surface. The intestine is drawn into the opening by means of traction sutures (*a*, *a*) passed through the anterior fibrous band of the intestine (Fig. 895), and it is then sewn to the skin and peritonæum in such fashion that two thirds of the circumference of the bowel will present outside the sutures; the sutures at the lower border are passed through the lower longitudinal band, and at the inner,

through the muscular coats of the intestine near to the mesenteric attachment (Fig. 896). In the later cases Cripps made the incision higher, nearly on a

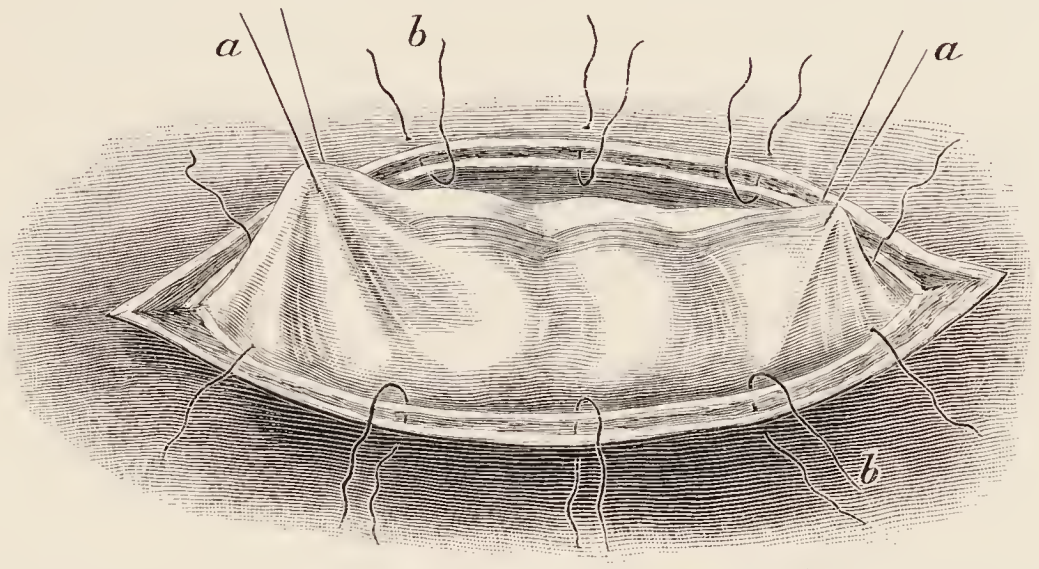



Fig. 895.—Iliac colostomy. Cripps's method. *a. a.* Traction loop passed through fibrous band. *b, b.* Sero-cutaneous sutures.

level with the umbilicus, in order that the lower part of the abdominal wall, "where the pressure is the greatest," may be spared as much as possible; also, he made the incision into the abdomen as small as practicable for a similar reason, and to prevent prolapse.

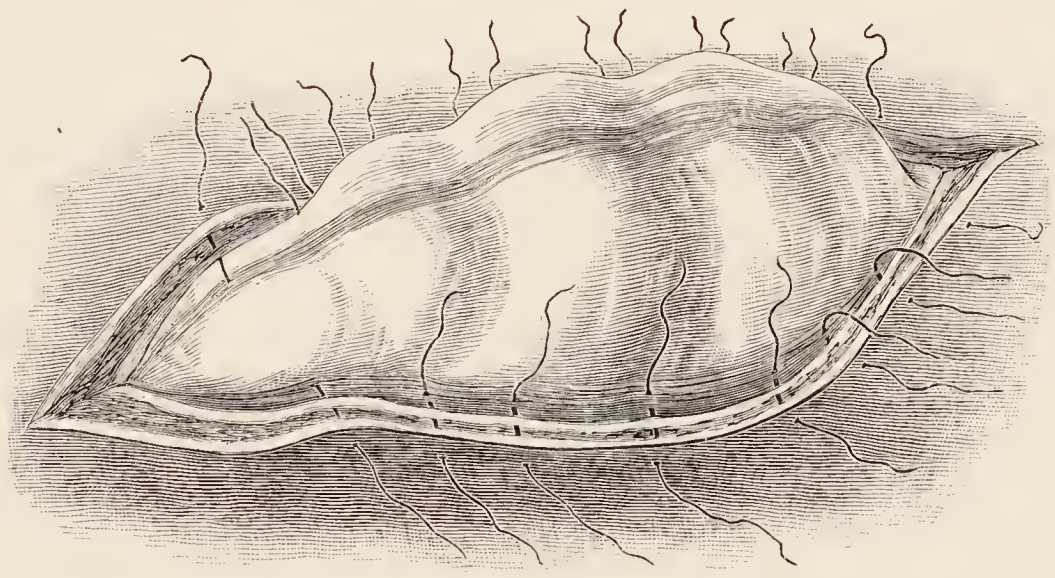


Fig. 896.—Iliac colostomy, Cripps's method. Intestine sutured in place.

*The After-treatment.*—The wound is dressed lightly with iodoform gauze, and is examined thereafter in twenty-four hours to note if proper union be maintained, and may not again be inspected until the time for opening the bowel has arrived.

**Réclus's Method.**—Réclus regards the preceding method as unnecessarily complicated, and advises the employment of local anæsthesia (cocain) and a short vertical incision (two-inch) located between the anterior superior spine and the umbilicus; also, pulling the colon (sigmoid) through the opening so as to expose the mesenteric attachment, and transfixing it and introducing the supporting rod out of line with the vessels, as low down as possible, to increase the prominence of the anal end of the gut. Simple aseptic dressings are then applied, and at the end of the third day the bowel is opened by a short longitudinal incision. Any distention happening before this time can be relieved by the passage of a fine trocar

obliquely into the gut. The supporting rod can be left in place for two weeks. The adhesion of the serous surface of the bowel to the tissues of the wall of the wound is regarded by Réclus as firmer than the union of serous surfaces with each other. *Hartmann* draws through a four-inch intermuscular dissection —the center an inch inside the spine—the sigmoid. He transfixes the mesentery with gauze, dresses the protrusion with it, and in forty-eight hours burns a small hole with cautery through the *anterior* longitudinal band at the upper limit of the wound. *Results* excellent in all respects; no stitches used.

**Iliac colostomy, right,** should not be employed except as a temporary measure. The anatomical obstacles and the physiological objections to it are of a pronounced character. The absence or brevity of the mesocolon making it difficult sometimes to properly unite the colon with the wound, and the fluidity of the fæcal contents produce frequent, unexpected, and irritating movements, which cause debility and distress, each of which emphasizes strongly the unwisdom of the practice of this method. The technique of entry to the abdomen here is practiced at a higher point, but in other respects is similar to that of the left side. When right iliac colostomy is performed a fistulous opening is desired, since it meets the demands of emergency and can be soon supplanted by anastomosis of the ileum with the descending colon or sigmoid flexure.

If the abdominal incision be located comparatively as in left iliac colostomy, the cæcum will appear at the wound, and can be easily joined with the borders by sewing. Only fæcal fistula can be established at this point. The physiological objections urged against opening the colon at the right side apply with a still greater force to opening the cæcum.

*The Comments.*—It may be necessary to open temporarily the cæcum to prevent its rupture because of distention due to obstruction of the distal part of the bowel. If right colostomy be attempted and failure attend the cæcum may then be opened.

**Colostomy of the transverse colon** is rarely performed, and then only when, for any good reason, the portion of the bowel beyond is unfitted for operation at the usual site.

**Lumbar Colostomy, Left** (Amussat).—Left lumbar colostomy was formerly the accepted plan of entrance to the colon. But the beneficent influence of asepsis in the prevention of peritoneal inflammation, together with the facts that the posterior incision produced greater traumatism and exposed broader surfaces to infection, while it offered no good opportunity for intra-abdominal exploration, and placed the artificial opening inconveniently, prompted the substitution of the anterior for the posterior method in the majority of instances.

*The Linear Guide to the Operation* (Fig. 897).—Draw a direct line between the anterior and posterior superior spinous processes of the ilium; draw a second one perpendicular to this, one inch posterior to its center, to mark the line of the colon. Draw a third line with the center corresponding to the perpendicular one obliquely downward and outward four inches in length, parallel with the lower border of the last rib and midway between it and the crest of the ilium, to mark the course of the primary incision.

*The Muscular Guides to the Operation.*—The superficial muscular guide is the outer border of the erector spinæ muscle; the deep one the outer border and anterior surface of the quadratus lumborum muscle.

*The Anatomical Points.*—A mesocolon is present at this situation in thirty-six per cent of the cases (Treves). If it be not present, the posterior and a greater or lesser portion of the lateral surfaces of the colon are uncovered with peritonæum. If the gut be collapsed, it retreats toward the median line behind the quadratus lumborum, followed by the peritoneal covering, and therefore exposes the peritonæum to a greater danger of injury than when distended, since it then presses the peritonæum outward, and itself extends beyond the border of the quadratus lumborum. The intestinal surface not covered with peritonæum is hidden by subserous fatty tissue abundant in corpulent subjects. The colon is separated at this situation from the kidney, crus of the diaphragm, and anterior surface of the quadratus lumborum respectively by fatty tissue. The small intestines when present here extend to the outer side of the colon. The kidney is placed behind the colon, and its upper end can be easily determined if the finger be directed upward through the wound. The ilio-hypogastric and ilio-inguinal nerves pass obliquely outward in front of the quadratus lumborum muscle, along with the abdominal branches of the lumbar vessels.

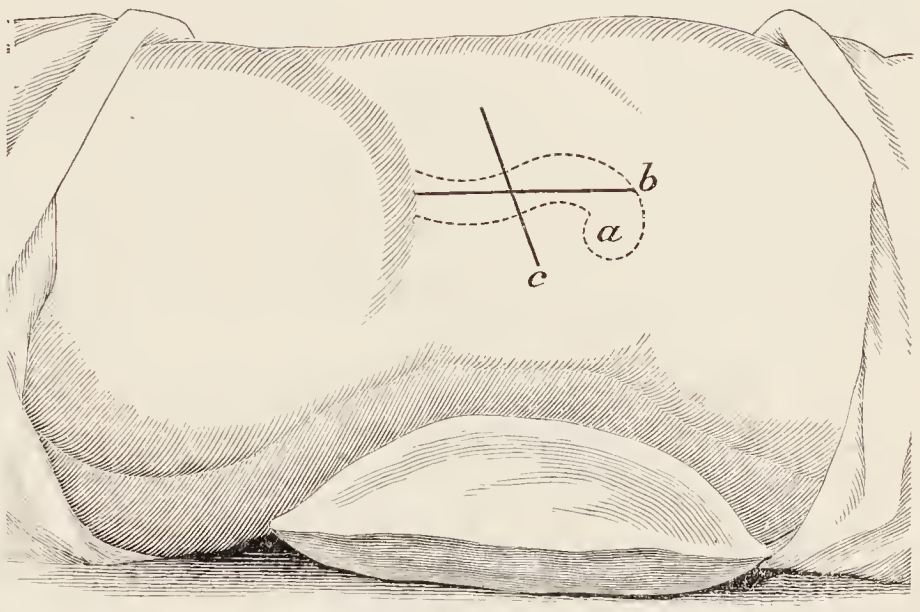



FIG. 897.—Iliac colostomy. *a*. Colon. *b*. Vertical line indicating colon. *c*. Line of incision in operation.

*The colon is recognized* by its greenish color, scybalous contents, and its thin longitudinal bands: one anteriorly, one posteriorly at the point of attachment of the mesocolon when present, and one internally. Although the colon is not quiet during respiration, yet it does not move upward and downward, as the small intestines are sure to do at this time. Moreover, the colon is so fixed as to resist upward and downward traction to any extent, while small intestines can be freely moved in every direction unless adhesion has taken place. Finally, inflation of the larger bowel with air will cause its distention as soon as relieved from its fatty environments.

*The Fallacies.*—The colon may be mistaken for a loop of small intestine, also for the kidney, especially in the young subject. It is easily distinguished from the former by the differences already stated; from the latter, by the greater density of the structure of the kidney, its rounded extremities, reniform shape, lobulated appearance, and the free movement of the kidney with respiration. Distention of the bowel by gas will quickly indicate its individuality. The fat beneath the transversalis fascia may be mistaken for the subserous fat, and consequently the transversalis fascia may

be regarded as the peritonæum. At the right side the stomach has been mistaken for the colon; at the left the duodenum for the colon. The physical characteristics of the colon, and, finally, the prompt distention of it by insufflation, should quickly correct either of these misapprehensions. In the instance of a collapsed colon provided with a mesentery, the peritonæum may

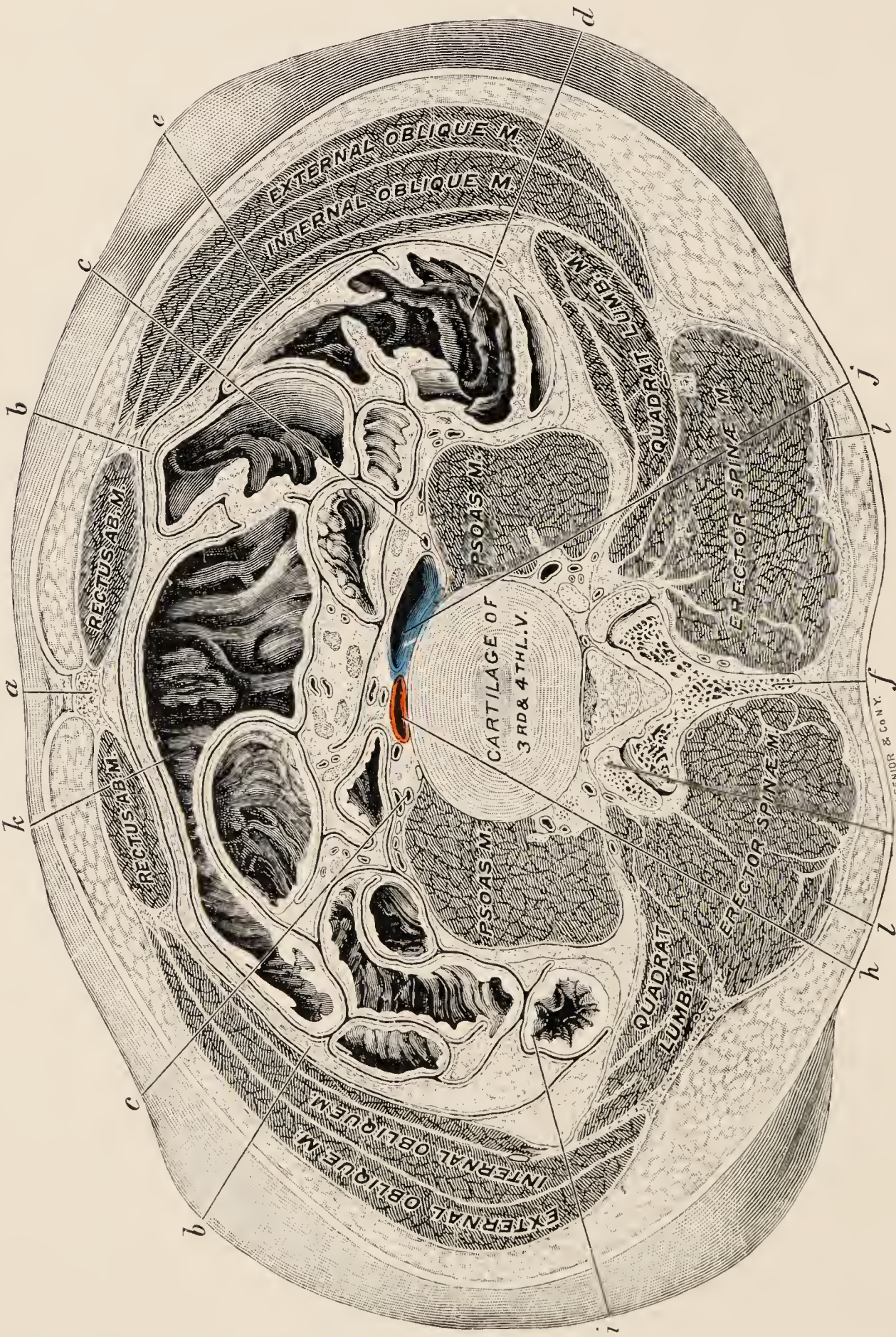



Fig. 898.—Transverse section of abdomen. *a*. Umbilicus. *b, b*. Great omentum. *c, c*. Ureters. *d*. Ascending colon. *e*. Transversalis muscle. *f*. Spinous process of fourth l. v. *g*. Articular process of third l. v. *h*. Aorta. *i*. Descending colon. *j*. Vena cava. *k*. Small intestine. *l, l*. Latissimus dorsi.

escape injury if the bowel be distended with air before it is opened, as then the entrance to it may be made between the mesenteric folds.

The colon may be misplaced or absent. If it can not be found at the left it should be sought for at the opposite side, and opened in two stages, if

practicable. If not found at all, or discovered at a point below the seat of obstruction, enterostomy should be practiced. A protrusion of peritonæum into the wound, caused by ascites or dependent on a long mesocolon, often gives rise to much perplexity.

*The Preparation of the Patient.*—If admissible, thoroughly cleanse the bowel. Place the patient on the sound side near the edge of the table, with the loin resting on a hard pillow or sand bag. Scrub and cleanse the field of operation and surround it with antiseptic cloths in the usual manner. Ether is commonly employed for anæsthesia.

*The Operation.*—Make an incision three or four inches in length in the course of the oblique line (*c*) already marked out (Fig. 897), carry it through the integument, fascia, and thick layer of fat usually found at this situation, down to and through the latissimus dorsi (*l*) and the posterior fibers of the external and internal oblique and transversalis muscles in their order, and thus bring into view the outer border of the quadratus lumborum incased in its compartment of the lumbar aponeurosis which passes outward and is continuous with the transversalis muscle (Fig. 898, *e*); carefully divide the aponeurosis, avoiding the twelfth dorsal nerve as it passes in front of the quadratus lumborum to gain the transversalis muscle. Draw apart the borders of the aponeurosis, along with the borders of the incision, with broad retractors or deep retraction sutures carried through the entire thickness of the borders of the wound. The fatty tissue lying between the aponeurosis and the transversalis fascia is now exposed and pushed aside.

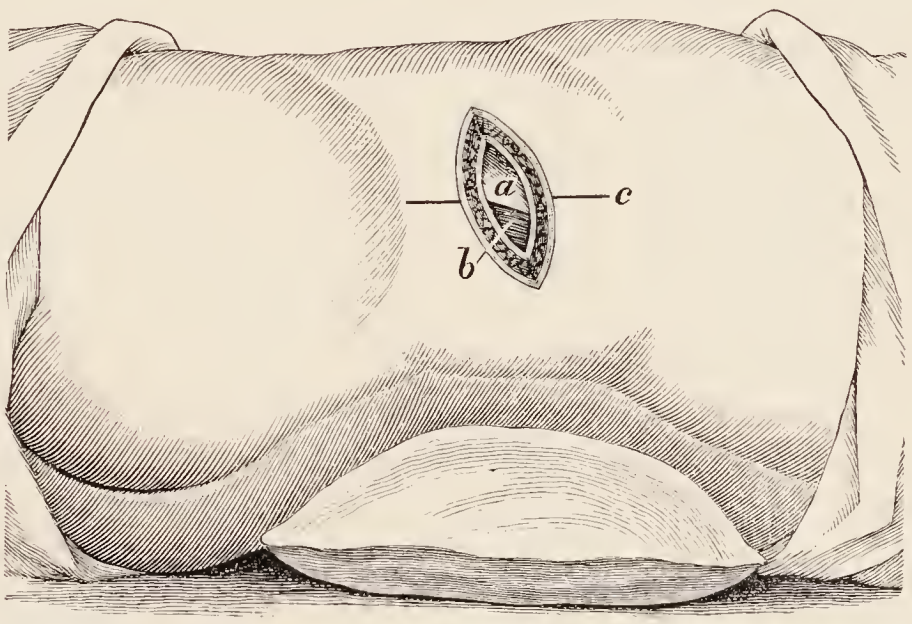



FIG. 899.—Iliac colostomy. *a*. Subserous fatty tissue. *b*. Quadratus lumborum muscle. *c*. Linear guide to colon.

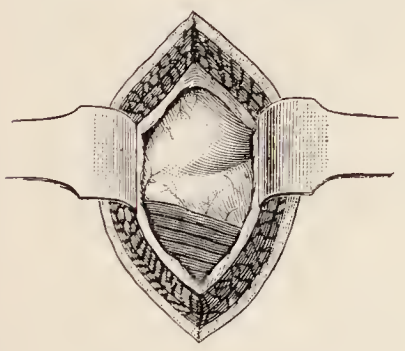


FIG. 900.—Iliac colostomy. Quadratus lumborum muscle below, fatty subserous tissue pushed aside, showing colon above.

Divide the transversalis fascia and bring into view the subserous fatty tissue (*a*); open and push this structure aside with the finger and handle of the scalpel, thereby uncovering the anterior surface of the sheath of the quadratus lumborum muscle, which can be seen lying behind it (Fig. 899, *b*). In the great majority of instances the intestine will appear in the wound as soon as the subserous fat is displaced (Fig. 900). If the gut do not appear at this time, insufflation of the bowel with air by means of an ordinary bellows will promptly produce the result, and it is then rolled outward with the fingers from beneath the quadratus muscle—cutting the outer border of the muscle if need be—so as to expose its inner aspect, which is recognized by

the presence of the longitudinal band. The passage of the index finger through the subserous fat in front of the transversalis fascia at the anterior surface of the quadratus lumborum to the psoas muscle (Fig. 898, *i*), and its withdrawal in a hooked manner with the body of the patient rolled toward the left side, with or without pressure in front, will roll the bowel outward into view when other means have failed to expose it. In passing the finger inward for this purpose, the outer border of the kidney will be felt, and the finger should be passed in front of the kidney as the colon lies at this situation. Verify the identity of the colon by means of the numerous tests already given (page 683). Should the peritonæum have been opened, close the breach with catgut sutures if it can be done readily, otherwise, let it alone, as the withdrawal of the bowel will close the opening and no harm can follow if the operation field be aseptic. Draw the gut outward to the surface of the wound by means of forceps, aided with pressure in front if necessary, and while it is retained in this position close the extremities of the wound with silkworm-gut sutures that shall include the tissues of the borders down to the lumbar fascia (Fig. 901). Tie these sutures, and then unite by sewing the surface of the bowel with the deep borders of the wound all around, the sutures passing through the muscular wall of the gut (Fig. 883). *If the case is urgent*, smear the wound and surrounding surface freely with iodoformized vaseline; place the patient on the back and open the gut longitudinally with a scalpel sufficiently to admit the extremity of Paul's tube (Fig. 892), which is tied in place, thus permitting the contents to escape into the proper receptacle without soiling the wound. If to the end of Paul's tube a piece of rubber tubing be attached, the discharges will be carried still farther away. In fact, rubber tubing can be employed from the first for the purpose, by inserting one end into the intestine. The amount and consistence of the intestinal contents will depend not a little on the previous treatment of the patient: constipated movements attending the administration of opium and copious discharges the use of cathartics. If the contents of the colon are compact, the borders of the opening are united to those of the wound of the abdomen before opening the gut (Fig. 902), if not, afterward, thus the better preventing infection of the wound.

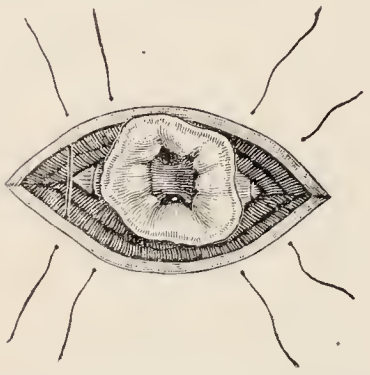


FIG. 901.—Iliac colostomy, showing colon opened and borders turned outward. Deep sutures laid for closure of extremities of wound.

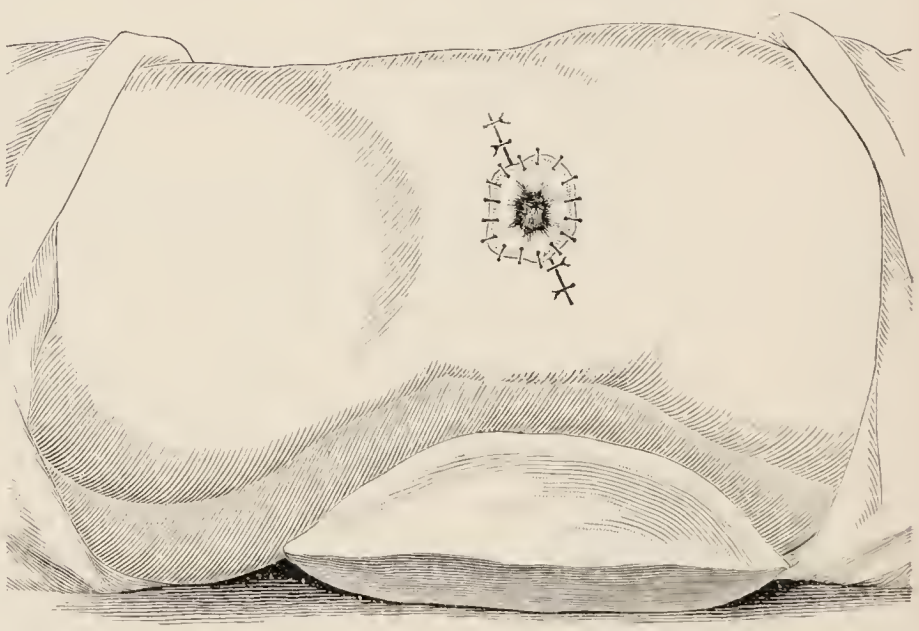


FIG. 902.—Iliac colostomy. Borders of colon wound united to integuments and subcutaneous tissue.

*If the case is not urgent*, the intestine when pulled well out of the wound can be transfixed with long, slim pins (Fig. 924), inserted transversely through the wall without penetration of the lumen, about three fourths of an inch apart, the extremities resting finally on iodoform gauze placed at either border of the wound. The margins of the wound are then carefully closed with chromicized-catgut or silkworm-gut sutures, and the walls of the bowel united at the same time to the cutaneous border of the wound with fine sutures of the same kind. The parts are covered with proper dressings, which after four or five days are renewed, and a crucial opening is made with a pointed bistoury between the pins. This method of practice divides the operation into two stages, thus lessening greatly the liability of local wound infection and its frequent and unfortunate sequels.

*The Precautions.*—Avoid mistaking the stomach at the left and the duodenum at the right for the colon. A displaced and hypertrophied loop of small intestine, or a prolapsed long mesocolon, may simulate the colon. If the wound be deep and the intestine be drawn taut when fastened to its borders the sutures should be supplemented with pin support to hold the gut securely in place. If scybalous matter be present at the opening it should not be disturbed unless necessary, and then with extreme caution, until firm union of the parts is established. The opening should be made as small as practicable to avoid subsequent prolapse of mucous membrane, and the diet of a kind to obviate constipation. The patient should lie upon the back, or toward the wounded side, until the union of the parts will safely withstand the traction of different postures.

*The Remarks.*—If the colon can not be found at the loin, it should be sought for through a median incision, and, if diseased, returned to the proper place and treated as before. Or, what is better, open the sigmoid in front if practicable. If neither of these measures be advisable, the cæcum can be entered through a median incision, or one made at the side as already described. Enterostomy can be practiced if the other plans offer no relief, but with a dubious outcome. If fæcal matter enter the distal segment of the intestine and cause trouble, it can be turned aside entirely by closure of the upper end of this part with mucous membrane displaced from the upper opening and fastened in place with sutures (Jones). The entire division of the gut is to be avoided, since peritoneal infection is very liable to arise from this measure. Many other complications of this operation occur, that are foreign to iliac colostomy, and the large number of perplexing contingencies already stated only emphasize the greater utility of the iliac route of entry.

*The After-treatment.*—The patient should remain in bed quiet, subsisting on a simple *regimen*, until the immediate dangers of the operation are gone and firm union of the parts is established. Measures to promote cleanliness and prevent irritation of the parts are of constant importance. The regulation of the diet to sustain the patient, keep the bowels soluble, and the discharges unirritating, are significant *desiderata*. When the wound is healed control of the opening is secured quite as well by simple pads fashioned by the patient to meet the needs which his experience suggests, as by those

planned only on the basis of theory. As a too small opening means fæcal dribbling, the opening should be maintained at proper size by dilatation with the finger, laminaria, or by special apparatus.

*The Results.*—The rate of mortality is variously estimated from 20 to 38 per cent. Somewhat recently (1884) Dr. Batt reported 244 cases with a death-rate of a little more than 31½ per cent. However, these figures can not be regarded as indicating the results of more advanced thought and method. The later reported experiences of Cripps and others are far in advance of those reported by Batt.

**Right Lumbar Colostomy.**—Lumbar colostomy at the right side is indeed rarely performed, and then as an emergency measure. The objections to the anterior opening at the right side apply with equal force to the posterior one at the same side. The colon is associated more directly with the abdominal wall at this than at the left side, as a mesocolon at the right side is ten per cent less frequent than that at the left (Fig. 898). The technique of the operation is similar to that of the left in all the stages, but the results are less propitious at the right, for easily understood physiological reasons.

**The Prognosis in Intestinal Obstruction.**—The fatal results attending operations for intestinal obstruction are truly frightful, and are caused much more by meddlesome medication yoked to complacency and procrastination, so often seen in these cases, than to all other influences. The persistent administration of cathartics and alimentation by the mouth fills prematurely to overflow the proximal segment of the obstructed intestine. Finally, purposeless delay, associated with ever-increasing accumulation, and infection causes great intestinal distention and paralysis, thus introducing new elements of danger to the patient of greater moment than the obstruction itself. As can be easily conjectured, the varied conditions of the patients represent every phase of involvement from the inception to final collapse, when the surgeon is called. It follows, therefore, that different methods of attainment of the object must be practiced in order to prolong, if not to save, the patient's life. In the majority of cases an operative procedure based on complete scientific technique can not be practiced at the outset without imminent danger to the patient.

*In the very urgent cases* the object should be to relieve the overdistended bowel at once, and thus bridge the chasm between an inevitable disaster and a hopeful outcome.

*The Treatment in these Cases.*—Before operation wrap the patient in hot blankets. Surround him with bottles of hot water; give hypodermatic injections of brandy, strychnine, etc. Under cocain anæsthesia perform enterostomy at the right, low down or at the median line below the umbilicus, while many of the preceding expedients are being carried into effect; introduce the finger and pull out a loop of intestine; hold it in place with the finger or fix it in the wound with sutures, as time will allow; open it longitudinally with a scalpel or evacuate it with a small trocar with a rubber tube attached, being careful in either case to prevent fæcal escape into the abdominal cavity. Administer hot, stimulating, and nutrient enemata, and wash out the stomach with hot water as soon as practicable. Put the patient

in bed surrounded with hot blankets or bottles of hot water, followed by a hot saline enema.

*In the less urgent cases* aseptic technique and general surgical preparation for operation can be made. In these cases the stomach should be washed out thoroughly before operation, especially if fæcal vomiting have occurred. Anæsthesia is utilized with care, and may be promptly supplemented with a small hypodermatic injection of morphin. Usually in these cases the author employs chloroform, since it is more agreeable, of quicker action, and less liable to cause vomiting. The incision is made in the median line and as nearly as possible to the seat of the obstruction, and large enough to admit the hand freely. Two strong retraction sutures are passed through each side of the wound including the peritonæum; each is then looped and given in charge of assistants. The borders of the wound are separated widely by traction on the sutures, the omentum pushed aside, and careful examination is made for collapsed intestine before introduction of the hand. If collapsed and distended intestine be noted lying in contact with each other, the seat of the obstruction is located somewhere in the line of contact of these differently conditioned portions of bowel, and probably at the right of the patient if due to bands, for there Meckel's diverticulum and the mischief-making vermiform appendix are found. It is the practice of the author to push upward the distended intestines carefully as a whole by the aid of broad, thin sponges or napkins, through an incision admitting of this procedure, till the collapsed ones appear; then, while the former are held upward, follow up the latter to the point of obstruction. By this course the seat of obstruction has been promptly located, and the temptation to eventration has not been experienced. In some instances partial removal and wrapping of the intestines in hot aseptic cloths was practiced on account of their extreme distention. If the jejunum alone be distended, the empty ileum will be overridden and pushed into the pelvic cavity, and for these reasons the abdominal distention will not be great, especially at the lower part. The degree and location of abdominal distention will be measured quite definitely by the extent of the involvement of the respective parts of the small intestine. The condition of the cæcum is a good key to the solution of the general seat of obstruction, for, if it be not distended, the seat of hindrance is in the small, and if distended, in the large intestine. Therefore, the prompt ascertainment of the state of the cæcum is a matter of considerable weight, since the attention is then quickly directed to the portion of intestine involved, and unnecessary handling of the structures and delay are avoided. The state of the vermiform appendix can be noted at the same time. The ordinary seats of hernial protrusions and the rare places of strangulation, as the diaphragm, the transverse mesocolon, foramen of Winslow (Fig. 984), etc., should not be overlooked in the course of examination. In cases of extreme distention, eventration is a wiser and prompter procedure than the forcible introduction of the hand, attended with the danger of serous membrane rupture and quite certain failure of finding the point of obstruction. In fact, the best interests of the great majority of this class of cases will be better served by enterostomy and subsequent repair than

by any other plan of procedure (page 670). Cases of obstruction must be treated according to the individual demands of each. In one, perhaps, the tedious process of unraveling and returning of the intestine loop by loop may be practiced in the search for the impediment, with the risk of going in the wrong direction. If the mesentery be straightened, the direction of its attachment to the posterior wall of the abdomen will suggest the course of the intestines. Irrespective of the plan pursued to find the hindrance, the latter should be removed as soon as found, and the intestines returned and the wound closed. Distended intestines attended with obstruction and paralysis should be evacuated through one or more small openings made with a scalpel at different situations (enterotomy), which are then promptly closed by sewing. The method of return of the intestine has already been described (page 666), along with the additional technique of treatment. In no instance should abdominal distention be present during or immediately after the closure of the abdominal wound. If overdistention prevent the locating of the seat of the obstruction, or the return of the intestines to the belly, free incision of one or more of the distended loops, and emptying out of their contents, will meet not only the preceding requirements but also prevent the evil influences of vigorous handling of the intestines and of autosepsis, likewise the disturbances of thoracic functions, so commonly associated with abdominal distention. *Greig Smith* advised that, in suitable cases, after the removal of the obstruction the distended intestines be emptied by the withdrawal of a loop and patiently utilizing, through a good-sized needle thrust into the bowel, the force of aspiration. By this plan the fluid and gaseous contents can be withdrawn in about half an hour, provided the suction be aided by gentle manipulation and contraction of the walls of the bowel. He believed that the leaving of a loop near the unclosed opening of the abdomen, for subsequent operation if needed, to be better practice than uniting the intestine to the walls.

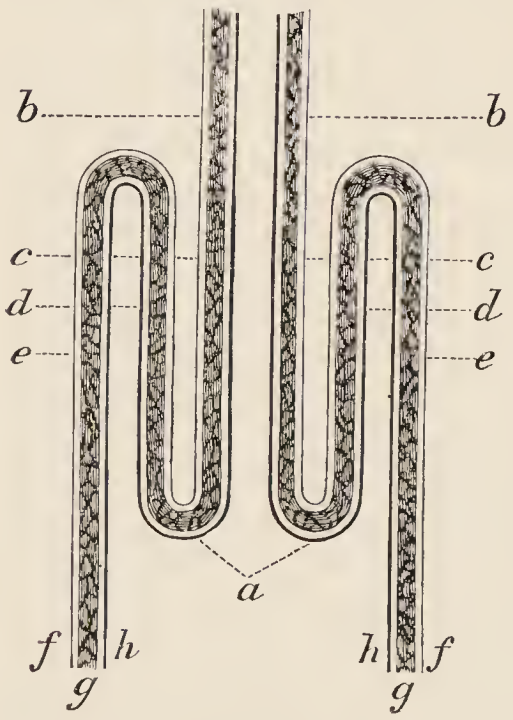



FIG. 903.—Single intussusception, vertical section. *a*. The apex. *b*, *b*. The neck. *c*, *c*. The entering layers. *d*, *d*. The returning layers. *c* and *d*. The intussusceptum. *e*, *e*. The intussuscipiens. *f*. *f*. The peritonæum. *g*, *g*. The muscular coat of intestine. *h*, *h*. Mucous membrane of intestine.

*The Removal of the Cause of Obstruction.*—The general technique of removal of the various causes of intestinal obstruction differs in no essential degree. The only changes in both general and special methods of action relate to the operative requirements of the different obstructive conditions and to the devious complications that often appear in these cases.

**Intussusception.**—In intussusception an upper portion of the intestine is invaginated into the lower; the reverse is seldom noted. Invaginations are usually single (Figs. 903 and 905), may be double (Fig. 904), and sometimes of a triple character. The outer part or sheath is denominated the *intussuscipiens*, the inner or invaginated part the *intussusceptum*.

Enteric invaginations happen in 30 per cent, colic, including the rectal, 18 per cent, ileo-cæcal 44 per cent, and ileo-colic 8 per cent of the cases. Intussusception is a prolific cause of intestinal obstruction at all ages (30 per cent), especially before eleven years of age, when it reaches 53 per cent. Only about half (48 per cent) of the cases are acute, the remainder are subacute (34 per cent) and chronic (18 per cent). The seat of the intussusception is at the ileo-cæcal region in 45 per cent, in the colon in 18 per cent, and the small intestine in about 12 per cent of the cases. The prognosis is very grave at the best, since 70 per cent terminate fatally, and three fourths of these succumb within seven days of the attack (Treves). Two methods of treatment are advised: 1, disinvagination by distention of the bowel with gas or fluid, aided by anæsthesia and manipulation; 2, abdominal section with either (*a*) manipulative disinvagination; (*b*) intestinal anastomosis; (*c*) artificial anus, with or without resection; or (*d*) resection of the intussusception and enterorrhaphy.

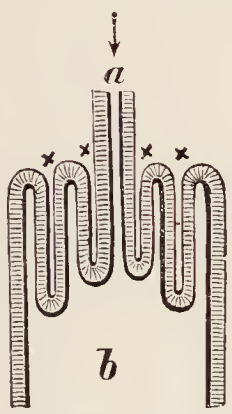



FIG. 904.—Double intussusception. *a*. The upper invaginated portion. *b*. The lower portion of the bowel.

*The distention of the intestine* by either of the preceding methods after two or three days' duration of the invagination, or in the presence of acute symptoms of even a lesser period, offers but little encouragement, indeed, of a favorable outcome, and when practiced the effort is made tentatively and briefly rather than with the assurance and repetition often permissible at an earlier period. In either method the patient should be anæsthetized and the distending force slowly exercised through the medium of a rubber tube passed well up into the bowel, and held there by pressure against the buttocks, so as to prevent the escape of the distending agent along the course of the tube. Air and gas can be forced by the ileo-cæcal valve, and are therefore useful in intussusception of the small intestines as well as the large. Water (saline solution), however, can not be forced by the valve with safety to the patient, and consequently is useful only in invagination involving the large intestine. The manipulation of the "sausage-shaped" tumor indicating the seat of invagination is of questionable utility, and should be carefully practiced by rolling the tumor from side to side, gently squeezing it, pressing backward at either end while the tumor is held as gently as possible with the hand. At all events, whatever is done in this regard should be done gently, and be relinquished promptly after trial.




FIG. 905.—Single intussusception, transverse section. *a*. The entering layer of intussusceptum. *e*. Space between entering and returning layers of intussusceptum. *f*. Lumen of entering segment. *d*. Space between returning layer of intussusceptum and inner surface of intussuscipiens. *c*. The intussuscipiens.

*The Distention with Air.*—In this instance the rubber tube is connected with a bellows which is slowly worked, while attended with a careful inspection of the abdomen to determine the seat of obstruction by noting the line of ascending distention if it be not obscured already by obstruction tympanitis.

*The Distention with Carbonic-acid Gas.*—For this purpose 3 drachms of bicarbonate of soda and 4½ drachms of tartaric acid are dissolved separately in water, and portions of either solution are passed alternately into the tube at intervals of six or seven minutes (Ziemssen). These solutions are employed thus slowly to obviate any danger of overdistention incident to a too rapid generation of the gas. The phenomena incident to this method of distention are scrutinized with the same care as in the preceding instance.

*The Distention with Hydrogen Gas.*—An ordinary rubber balloon with a capacity of from two to four gallons is the simplest, safest, and most efficient instrument for making rectal insufflation (Senn). The balloon is connected by a metal tube to a rubber one, and the gas is slowly discharged through the latter into the bowel by compression of the bag with the hands. The balloon is a better agent by far for the introduction of air than the bellows or any mechanism of a less deliberate action. The gas should be discharged slowly through a stopcock easily regulated and of a caliber not larger than a line or two in diameter at the point of exit. During the introduction of the gas the patient should lie on the back to afford the surgeon the opportunity to outline the course of distention, and especially to recognize the passage of gas through the ileo-cæcal opening, which is indicated by a gurgling sound that not infrequently can be heard several feet away from the patient. A sudden lessening of the pressure in the use of either agent indicates that disinvagination has taken place, or that rupture of the intestine has happened. If the latter have occurred the escape of gas from the intestine into the peritoneal cavity, together with the additional amount slowly introduced through the tube under low pressure, will cause a general tympanitis with loss of liver dullness; increasing dullness on percussion indicates the escape of fluid; while in disinvagination decreased pressure is followed by continued upward intestinal distention in a regular manner, and the presence of liver dullness.

*The Distention with Fluid.*—As before remarked, the benefit of liquid distention is limited to involvement of the colon. The common method of practice is to pour the fluid into a funnel held about three feet above the patient and connected directly with the outer end of the intestinal tube. The fountain syringe can be employed instead. The patient need not be inverted during the administration. The capacity of the colon in the adult is from a gallon to a gallon and a third. In the infant from ten to twenty ounces. The introduction of the fluid should be done slowly, with the head placed low and the pelvis raised. Sometimes this plan is practiced without the use of an anæsthetic. Lukewarm saline solution is commonly employed, but warm oil can be used instead.

*The Remarks.*—Prolonged distention with low pressure is more serviceable and less risky than rapid distention with high pressure. It is impossible to estimate definitely the amount of fluid and the degree of pressure that will cure or can be safely borne in all cases. If rupture happens, abdominal section must be done at once. Strong objections are made against the use of any distending agent by some, because of the uncertainty and delay of relief, the danger of rupture, the deceptive results, and the fickleness of cure.

*The Results.*—The employment of either of the preceding measures, before adhesion shall have taken place between the invaginated portions, is commendable. The earlier the use, the safer and the more favorable is the outcome. After two or three days have elapsed, the prospect of benefit and the danger of the attempt are inversely proportioned. The employment of gas or air offers the best means of treatment with a minimum danger of use, provided proper care be exercised in the administration. And, too, their influence is more extended than that of fluids, as the effect of the latter is limited to the large intestine alone. Still, the circumstances attending the case often require the utilization of fluids as the simpler and more available means of treatment. In 72 cases of all degrees of severity reported by Wiggin, intestinal distention failed in 54 instances. *Barker* reported 42 cases, 11 of which were treated by injection only, with 9 recoveries; 16 cases in which injection failed were treated by abdominal section, with 8 recoveries; 15 cases by abdominal section only with 7 recoveries. In 50 cases treated by distention, the average time from the onset of the obstruction is three hours and a half in the successful cases and about forty hours in the unsuccessful.

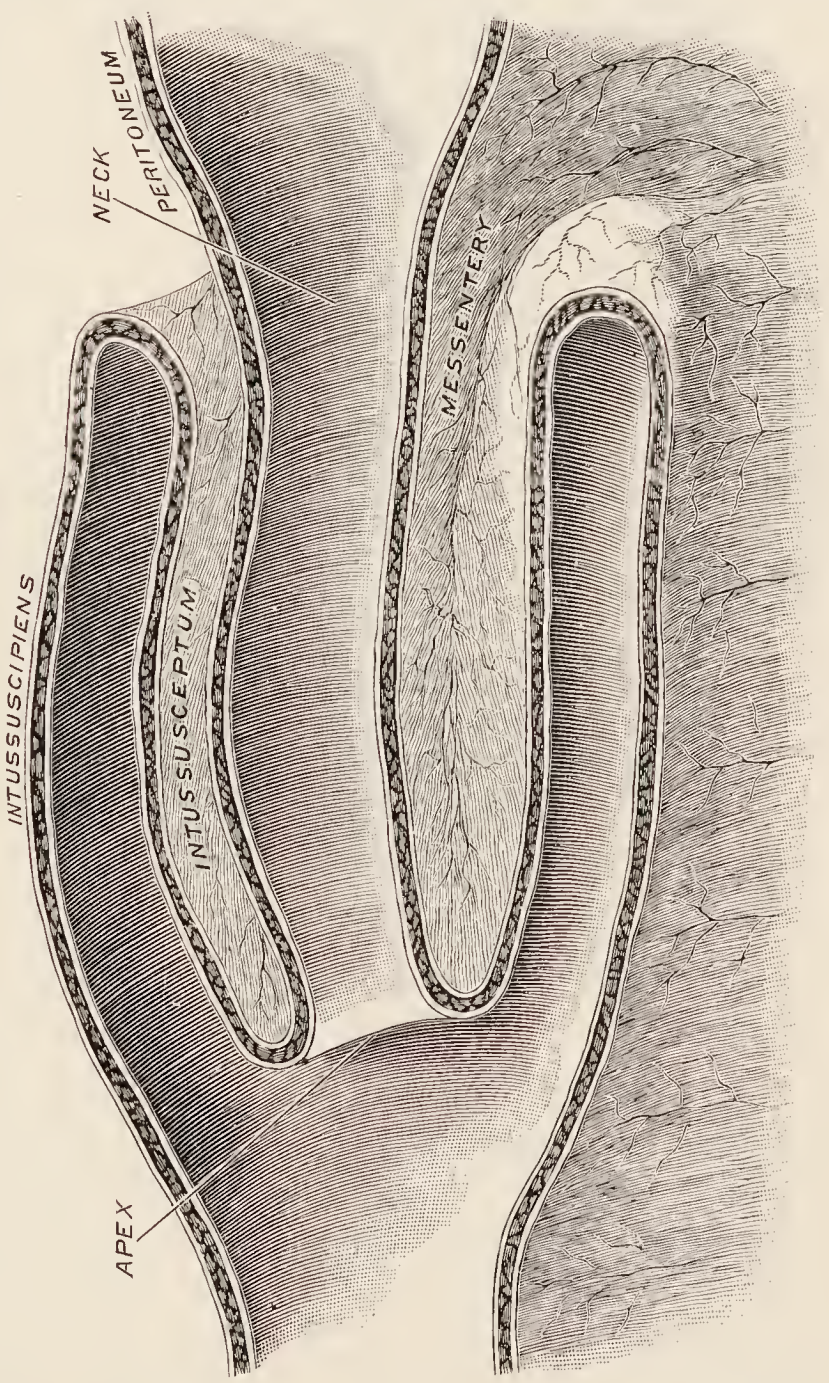



FIG. 906.—Single intussusception, longitudinal section. Showing the relations of the important parts of the intussusception.

*Abdominal section* (page 607 *et seq.*) should follow promptly in these cases after failure of the preceding means of treatment with the view of securing relief by other and more active measures. The age of the patient is no bar to the attempt, for all ages have been rescued by the measures which at this time offer the main hope of relief. It is proper to say, however, that the successful issue will depend largely on the promptness of the performance, and the knowledge and the ability to carry into effect the requisite surgical technique.

*The Reduction by Manipulation.*—For this purpose the abdominal incision should be made in the median line as near as possible to the site of the tumor, and long enough to permit of prompt and effective handling of the invaginated part. After exposure of the seat of the intussusception and

its careful isolation with hot, moist, aseptic surroundings while within or after withdrawal (the latter preferable) from the abdominal cavity, a cautiously directed effort at restitution by manipulation is made by grasping the tumor between the hands and carefully yet firmly squeezing it from the base to the neck, so as to reduce the size of the œdematous intussusceptum, thus enabling restitution to follow gentle traction at the neck made in the long axis of this part of the tumor (Fig. 906). If adhesions be present between the serous surfaces of the invagination, it is advised by some surgeons that they be broken up by a blunt probe or the end of the finger. As the constricted neck of the tumor will hardly admit the end of the finger without causing rupture of the gut, and as the presence of adhesions so strong as to require mechanical severance bespeaks impossible reduction, these bits of advice should be accepted with reluctance and be applied with apprehension (Figs. 907, 906). *Hutchinson* advised that the intussuscipiens be drawn downward instead of pulling the intussusceptum upward, as is so often recommended. At all events, careful traction in both directions should be practiced after the reduction of the œdematous swelling by squeezing, never forgetting that a too vigorous or prolonged effort at reduction greatly compromises the integrity of the gut and depresses the vitality of the patient, who is thus perhaps robbed of the benefits of other expedients in case of a failure of this. After restitution of the intestine to its normal relations it should be examined carefully to detect any evidences of injury or points of uncertain vitality that may be present and require surgical attention. It may be wiser in some instances to isolate the parts of the intestine of questionable vitality with iodoform gauze, and leave them outside of the abdomen, or inside even, pending Nature's solution of the doubt, rather than to sacrifice unduly the injured portion, or the patient's opportunity of recovery, by attempts at immediate repair. When the integrity of the gut is assured, any accumulation of fæces or gases collected in the prox-

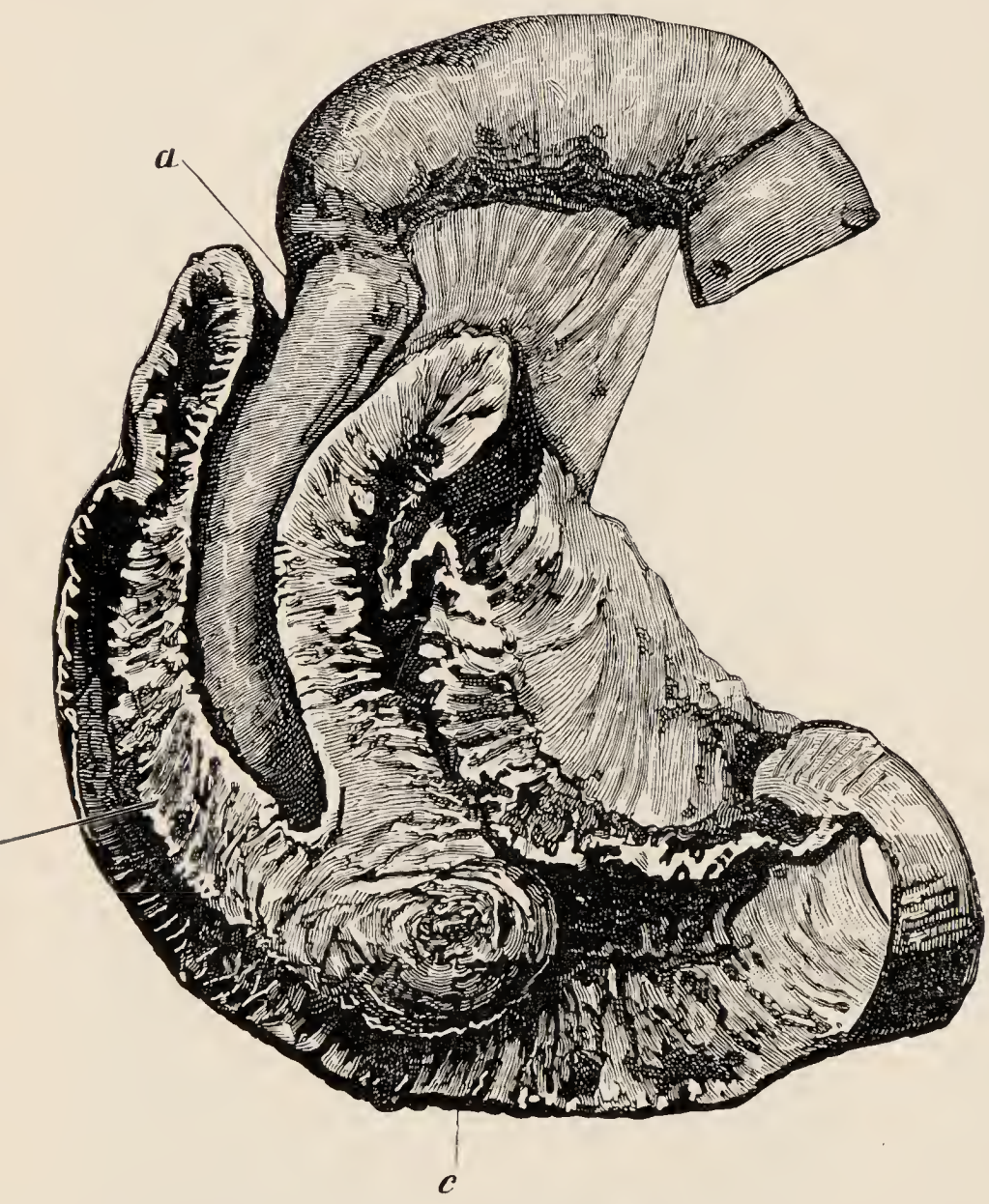



FIG. 907.—Intussusception of the jejunum. *a*. Internal cylinder. *b*. Middle cylinder. *c*. External cylinder.

imal portion of the intestine should be caused to pass along the disinvaginated part to a healthier portion before closure of the abdomen, in order that any obstruction at the impaired part of the intestine may be obviated until the function of the bowel is restored. A failure to reduce the intussusception calls prompt attention to the advisability of the adoption of other measures.

*The Remarks.*—In rare instances reduction is accomplished easier at a later than at an earlier period. The tumor should be straightened as much as possible before reduction is attempted. Squeezing the intussuscipiens at the apex of the tumor is serviceable. Traction on the intussusceptum should be avoided in severe cases. Circumscribed thickening of the gut and thickening of the ileo-cæcal valve may be mistaken for incomplete reduction, requiring incision to make the distinction. Small doses of opium should be given for a few days to quiet peristalsis and relieve pain.

*Lateral Anastomosis.*—If the intussusception be a small one, and the involved intestinal structures be of undoubted vitality, and the condition of the patient admonishes the employment of a brief and expedient measure, one loop of intestine is selected at the proximal and another at the distal aspect of the obstruction, the surfaces of which are brought in contact with each other longitudinally and without tension, and joined by means of either the decalcified bone plates of Senn, the round or oblong button of Murphy, the potato plates of Dawbarn, or by suturing, as practiced by Halsted and Abbe (pages 629, 640 *et seq.*). Which one of the preceding measures should be adopted is largely a matter of technical expediency, which can be decided by the surgeon himself at the time of the operation. The portion of the intestine excluded from the channel of fæcal flow by the operation appears thus far to invite no unfavorable outcome, but remains both inactive and innocuous to a satisfactory degree.

*The Establishment of an Artificial Anus.*—Artificial anus may be established with or without resection of the invagination. In the former instance it will likely take the place of a completer technique (enterorrhaphy) owing to the inability to properly conclude the operation as at first intended. Resection is not permissible in the presence of extensive invagination or great prostration. The establishment of an artificial anus *without* resection is applicable to those cases in which a fatal outcome would soon follow a more deliberate procedure. The method of performance is described under the head of enterostomy (page 670 *et seq.*).

*The Remarks.*—Regarding the last two preceding methods, but little can be said in their favor, as the former leaves behind a gangrenous intussusceptum and is almost always fatal. The latter plan is no less grave than the former. Either may prolong life, but neither is at all likely to effect a cure.

*Resection with Enterorrhaphy.*—The resection of the involved segment, and the union of the divided ends of the intestine by sewing or by the circular button of Murphy, has a limited application, and is not advisable in the presence of a knowledge of the more rational plans of Maunsell, Barker, or Paul.

*The Remarks.*—The results of resection of the intussusceptum and union of the divided ends by any method are of the gravest character, being almost uniformly fatal. A patient able to bear this operation is quite likely to be rescued by either of the following. However, if the intussuscipiens be gangrenous, this course must be taken, and end-to-end union, or lateral implantation of small intestine into a healthy part of the colon practiced, followed, perhaps, by temporary colostomy of the cut end.

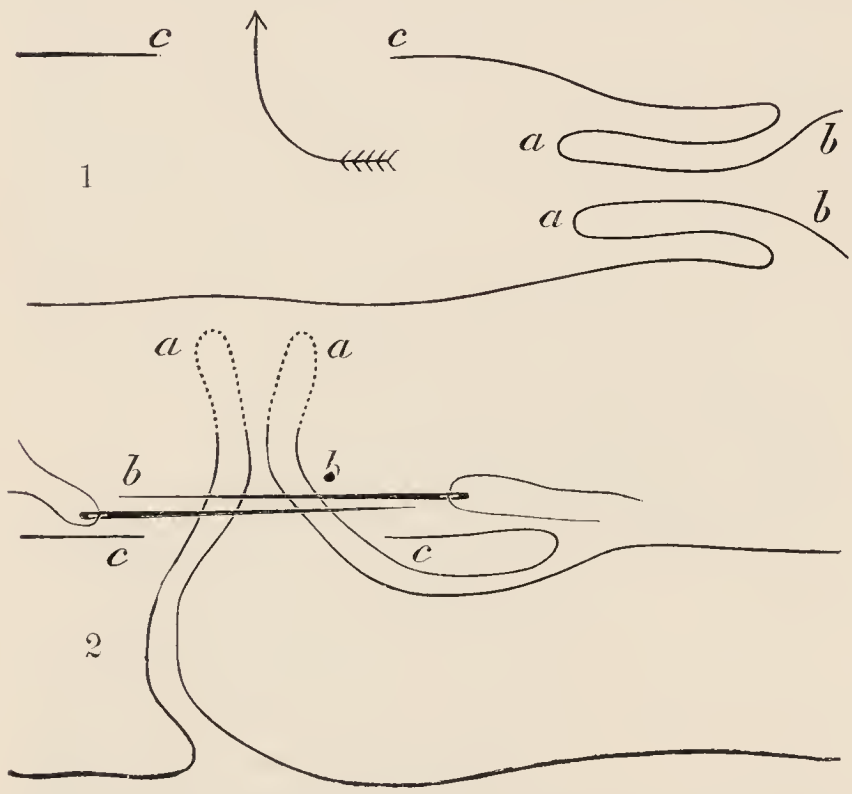



Fig. 908.—The treatment of intussusception, Maunsell's method. 1. *a, a.* Apex of intussusceptum. *b, b.* Neck of intussusceptum. *c, c.* Longitudinal incision through intussuscipiens. 2. *a, a.* Point of division of neck (dotted line). *b, b.* Sewing of neck. *c, c.* Intussuscipiens.

*Maunsell* (Fig. 908) advised that a longitudinal incision (*c, c*) be made through the intussuscipiens (1) down upon the intussusceptum, and that the latter be drawn through this opening sufficiently to bring the apex (*a, a*) and neck (*b, b*) of the invagination well into view, and then held firmly in place while the neck is divided transversely across (*a, a,* 2) and the open ends are sewed (*b, b,* 2) in the manner already described (page 626). The part is then disinvaginated by gentle traction, the longitudinal opening closed, and a few additional sutures are applied at the neck to strengthen the union.

**Barker's Method.**—*Barker's*, like Maunsell's method, comprehends the excision of the intussusceptum and its removal through an incision made at the convex surface of the intussuscipiens.

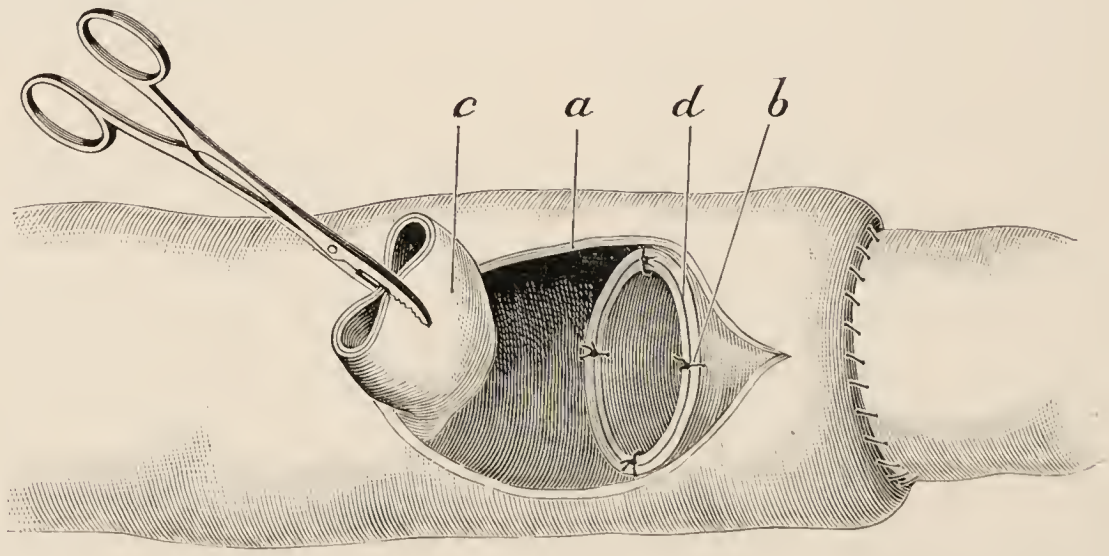



Fig. 909.—The treatment of intussusception, Barker's method. *a.* Intussuscipiens. *b.* Sutures. *d.* The divided border of the intussusceptum. *c.* Divided segment of intussusceptum.

The opposed serous surfaces of the entering and receiving portions at the neck of the invagination are united together by a continuous suture of fine silk, carried so as to include the seromuscular coats of both portions. A longitudinal incision is then made at the convex border of the intussuscipiens down upon the intussusceptum (Fig. 908, 1, *c, c*) of suf-

ficient length to permit the ready removal through it of the latter body, which is then amputated as near as possible to the upper end (Fig. 909). Stout silk ligatures are passed through the walls of the stump (*b*) and tied firmly, to keep the serous surfaces in contact and control the bleeding points. Usually four to six sutures are employed, the introduction being so timed as to keep pace with cutting away of the intussusceptum. The last suture controls the circulation in the stump of the mesentery, which is not divided until after the suture is tied. The part is then cleansed, dried, dusted with iodoform, dropped into the lumen, the longitudinal incision closed as in Fig. 807, and the borders of the abdomen are united as in other instances.

*The Precautions.*—It should be noted whether or not the lumen of the intussusceptum is clear before the longitudinal opening is closed. If it be impossible to remove the intussusceptum after section, it may be loosened and permitted to come away with the stools. If the stability of the technique or the possibility of gangrene be suspected, a gauze drain should be introduced from without and be permitted to remain until the danger is passed.

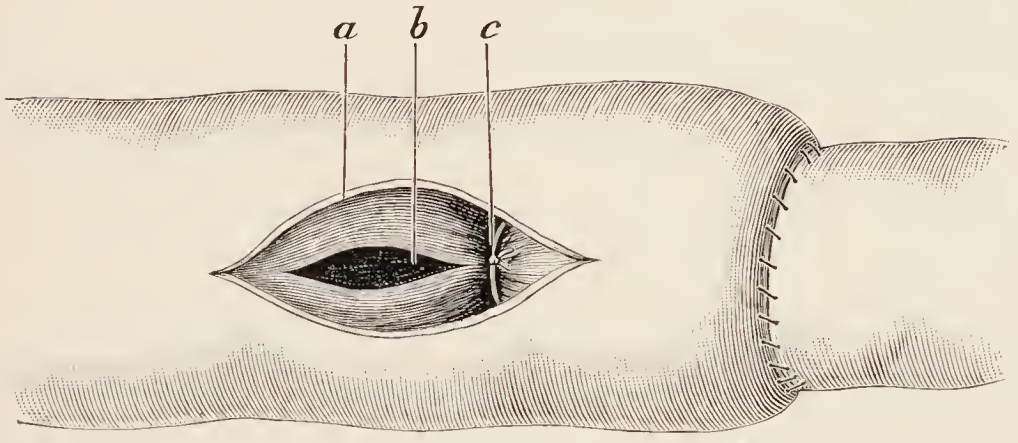



Fig. 910.—The treatment of intussusception, Paul's method. *a*. Longitudinal opening in intussuscipiens. *b*. Longitudinal opening in intussusceptum. *c*. Ligature thrown around intussusceptum and spool.

*Paul's modification* of Barker's method can be more quickly performed than the latter, because a spool and ligature are substituted for sewing in the removal of the intussusceptum. However, the plan is not practicable when, as sometimes happens, the lumen of the intussusceptum will not receive the spool. The serous surfaces at the neck are united with sutures; a longitudinal incision through the intussuscipiens is made, as in Barker's operation (Fig. 909). A longitudinal incision is then made into the lumen of the intussusceptum of sufficient length to admit the metal spool, which is carried into place and held by a strong suture passed around the intussusceptum where it grasps the spool, and tied (Fig. 911). The intussusceptum is cut away, the longitudinal opening in the intussuscipiens closed, parts are returned,

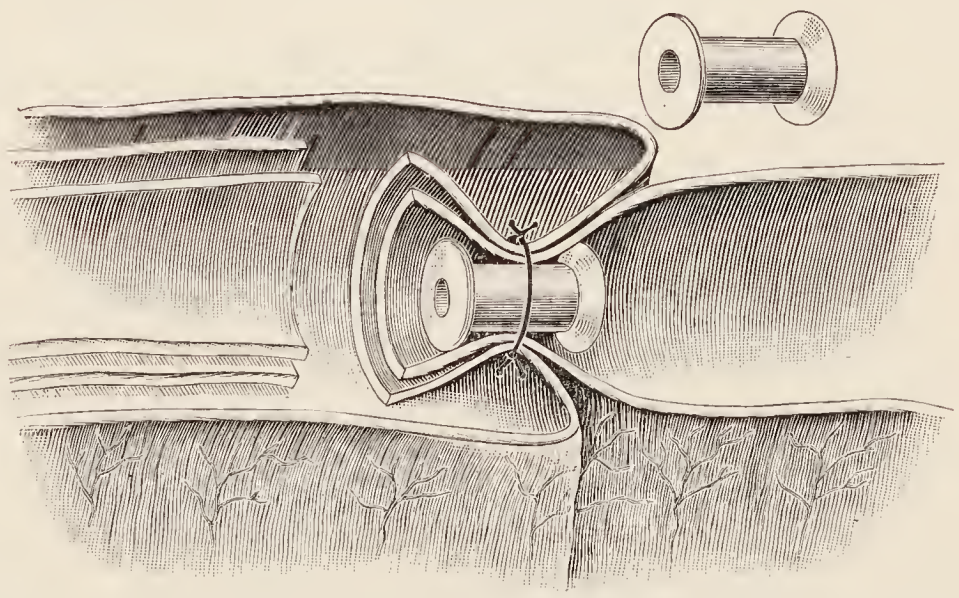


Fig. 911.—The treatment of intussusception, Paul's method. Longitudinal section showing metal spool in position.

and the abdominal wound is closed. This modification seems to present the alternative between quicker practice and the danger of prompter and more decided intestinal contraction.

*Irreducible invaginations* of the small into the large intestine can be treated in various ways as circumstances will permit: An artificial anus can be established at the lowermost part of the small intestine, the distal portion of which should be sewed firmly to the abdominal wall, and even clamped with forceps, to oppose any further invagination. The employment of Maunsell's or Barker's method of treatment may be thought proper in some of these cases, even though the intussusceptum can not be entirely withdrawn, for if divided it may promptly escape.

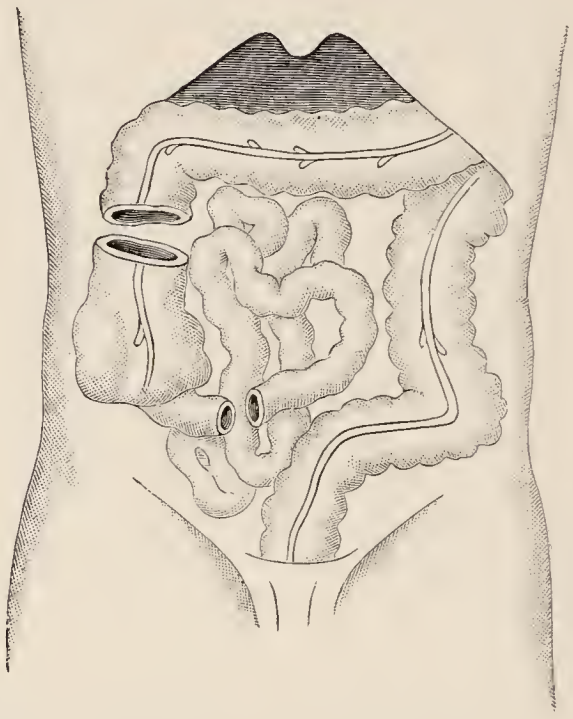


FIG. 912.—The treatment of ileo-cæcal intussusception, Baracz's method. Isolation of the tumor.

*Baracz* successfully treated a case of irreducible ileo-cæcal invagination by isolation of the tumor (Fig. 912), and repair, by lateral anastomosis of the closed end of the ileum with the colon, above the point of occlusion (Fig. 913). As before remarked, no ill effect appears to follow the retention in place of the occluded portions of the intestinal tract.

*Prolapsed invaginations* are treated better by the plan of Mikulicz than by the older methods of procedure (Fig. 903). *Mikulicz* pulled down the intussusceptum (*a*) until its upper limit appeared, then made an incision transversely across its anterior surface, going carefully down to the peritoneal covering of the returning layer (*d*), then through it into the peritoneal cavity, arresting hæmorrhage as it occurred. The adjoining peritoneal coverings of the two layers (entering and returning) of the intussusceptum (*c*, *d*) were united together at the point of severance with a row of fine silk Lembert sutures. After a similar treatment of the posterior half of the surface, the intussusceptum was removed and the respective coats of the inner (entering) layer of the invagination (*c*) were joined with those of the middle (returning) layer (*d*) previously divided, except the peritoneal covering, which had been already united as a preliminary measure. This method not only shuts off the peritoneal cavity above the point of constriction before the intestine is opened, but also unites firmly the respective layers of the intestine with each other, thus preventing infection of the

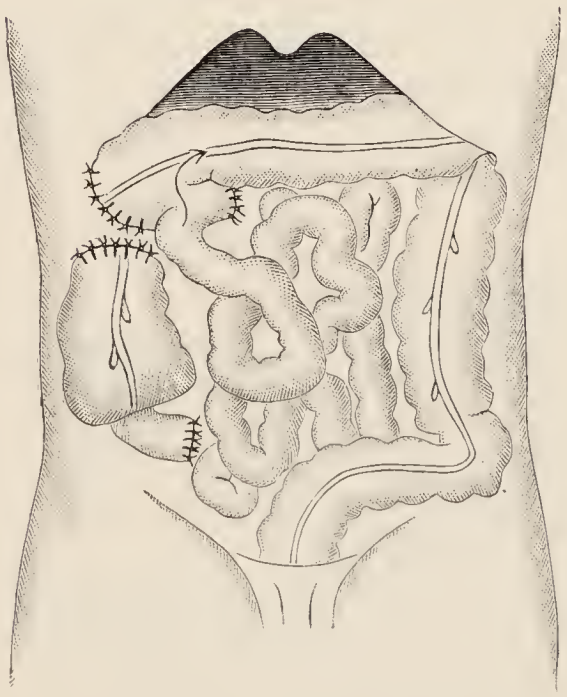


FIG. 913.—The treatment of ileo-cæcal intussusception, Baracz's method. Isolation of the tumor and closure of the divided extremities. Enterocolic anastomosis.

raw surfaces and the consequent danger of non-union and peritoneal inflammation. In a time of emergency in this class of cases a stiff tube may be passed through the intussusceptum, around which the gut is ligatured at the upper limit with a strong rubber cloth, causing it to slough away as the serous adhesions take place.

*The Results of Cœliotomy for Acute Intussusception.*—"Out of sixty-five cases in which the intussusception could be reduced, thirty-eight died, a mortality of fifty-eight per cent. Among the children of this group, the mortality was sixty-six, among the adults forty-seven per cent. Of seventeen cases in which the affected bowel was resected and sutured, only two recovered, both adults. Of sixteen cases in which an artificial anus was made (with or without reduction or resection of the intussusception), two cases recovered, also both adults" (Curtis). Prolonged and delayed operations are nearly always fatal. The danger of relapse after reduction of the invagination ought not to be overlooked. To prevent relapse, Senn advises the making of a fold in the mesentery parallel with the long axis of the bowel, and sewing it in position with silk sutures, carefully avoiding any impairment of the circulation of the intestine. The need for this step is not generally recognized.

**Volvulus.**—Volvulus consists in the twisting of a loop of intestine on its axis so as to obstruct its lumen and vascular supply. It happens more frequently at the lower part of the ileum and at the sigmoid flexure, because at these parts the mesentery is the longest. The sigmoid flexure is involved in about a half, and the ileum a third of all the cases. Volvulus occurs about four times as often in the male as in the female, and usually between forty and sixty years of age in both sexes. Attempts are often made to untwist the intestine by external manipulation. However, the delay in diagnosis and the uncertainty of the direction of the twist, makes the attempt dangerous and success impossible at the outset. Abdominal section offers the only rational means of treatment of this obstruction.

*The Operation.*—Make an incision in the median line large enough to admit the hand; draw apart the borders of the wound by means of traction sutures passed through all of the tissues of either border; push aside the omentum and examine the field for distended intestine, which is usually seen at once; draw out of the wound the distended portion and examine for the seat and direction of the twist. If found, it should be untwisted if possible. If much distended, the contents of the loop and of the intestine above should be evacuated through a short longitudinal slit made at the convex border of the untwisted gut with a scalpel. The intestine is then washed out with sterilized water or Thiersch's fluid, the opening closed, and the intestine returned. If the loop first withdrawn offers no solution as to the seat of the twist, additional loops are removed in their order and evacuated, if need be, until the seat of the obstruction is felt or brought in sight. Whenever a distended loop interferes with the untwisting, the evacuation of the contents facilitates the manipulation, saves time, and lessens the danger of injury to the gut. If it be impossible to unwind the pedicle on

account of adhesions, after the volvulus is evacuated, either of the following methods can be practiced :

1. Lateral anastomosis of the proximal and distal parts of the intestine as near to the seat of the obstruction as practicable, thus removing the obstructed loop from the line of fæcal flow (Fig. 829).

2. Resection of the loop and union of the intestinal extremities by the end-to-end or lateral approximation methods (pages 624, 645).

3. The establishment of an artificial anus.

Which of these expedients is entitled to precedence will depend on the condition of the patient and the equipment of the surgeon. If the intestine be greatly disturbed, or the patient be much depressed, a temporary artificial anus, followed later by completer repair, affords the best outlook (page 670).

*The Remarks.*—It is regarded as wise to evacuate and cleanse the overdistended intestine of a volvulus after reduction, since paralysis and softening of the walls of the gut promptly follow this condition, and, if unrelieved, often cause continued obstruction there from loss of peristaltic function in the presence of a large fæcal accumulation. The normal attachments and the direction of the sigmoid mesocolon cause the gut to flex and commonly turn outward to the left when distended with air in experimental instances, a fact which suggests that the manipulation for the reduction of volvulus of the sigmoid be directed from left to right. In volvulus of the sigmoid the abdominal incision must be made of a liberal size, to permit of the prompt and safe withdrawal of the gut before attempted rectification. The employment of rectal injections and the introduction of the hand into the bowel should not be practiced except for the purposes of diagnosis, and even then the hand must be of small size—about seven inches in circumference—and be inserted with great care. All defects in the structure and vitality of the gut arising from volvulus must be carefully sought for and repaired before the bowel is returned.

*The Results.*—Established cases of volvulus are hopeless if left to themselves, death usually occurring in the first week. About 50 to 70 per cent die after the relief afforded by abdominal section. Relapses are liable to happen, as the operations for cure afford no protection against this contingency. The shortening of the mesentery by making a longitudinal fold parallel with the long axis of the intestine, and fastening it in place with silk sutures (Senn); fixation by the sewing to the abdominal wall of the sigmoid mesocolon (Roux), or of the bowel itself (Gould), and the fixation attendant on a temporary artificial anus, are tested methods of successful practice. Excision of the distended loop has been suggested (Obolinski).

**Neoplasms.**—Neoplasms not infrequently cause intestinal obstruction, irrespective of those connected with the rectum. These growths offend by lying upon or by involving the intestinal structure. If obstruction arise from tumor pressure, the growth should be removed in the manner best calculated to meet the requirements of good surgical technique. If the neoplasm be inseparably connected with the intestinal structure, the portion of intestine and mesentery involved should be removed, along with the

growth and enlarged glands, and the ends of the divided gut united by end-to-end, or the lateral apposition method. If the patient's condition or the extent of the disease do not warrant resection, the growth should then be excluded from the intestinal channel by lateral anastomosis of the intestinal loops continuous with the growth, in such a manner as to avoid undue traction on the loops, and at the same time economize as much as possible in the length of the intestinal tract. The technique of these procedures is sufficiently explained already under the consideration of enterectomy and the various methods of intestinal union (page 654 *et seq.*).

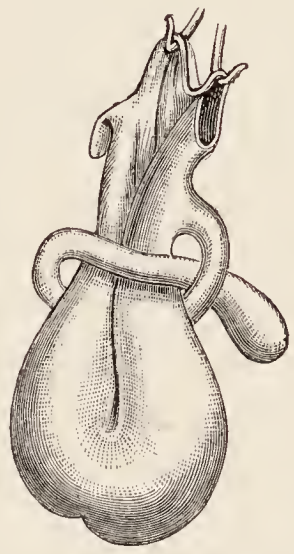


Fig. 914. — Strangulation caused by an intestinal diverticulum which had wound and fastened itself about a loop of intestine.

*Diverticula* (Fig. 914), *bands* (Fig. 915), *slits*, *openings*, etc., cause intestinal obstruction not infrequently. The right iliac and pelvic regions are the special seats of this class of constricting agents, because of the location there of the vermiform appendix, Fallopian tubes, and uterus, whose natural arrangement and acquired infirmities contribute largely to the frequent presence of intestinal pitfalls in these parts. Meckel's diverticulum is also in this vicinity, and its agency contributes about twenty-two per cent of the entire number (hernia excluded) of the cases of obstruction dependent on bands, diverticula, etc.

The abdominal incision, exposure of the contents, and the search for the seat of constriction are each carried out in accordance with the previous description of like procedures. The right side should be examined first for apparent reasons. Bands and diverticula should be removed entirely when possible; they should be ligatured outside the points of division to prevent any bleeding that may attend their severance. The division of a patent diverticulum should be guarded against, since by this occurrence not only blood but infecting products may escape into the peritoneal cavity; the open extremities should be closed by inversion and sewing, the same as in dealing with intestines, and then returned to the abdominal cavity. Comparatively little trouble attends the finding and treatment of bands, but if gangrene of the intestine be present or threatened, the case then assumes a graver aspect. However, the detection and treatment of these complications have already been given due consideration. Abnormal openings in the mesentery, omentum, and abdominal walls should be closed to prevent a repetition of the infliction resulting therefrom. Of course, in desperate cases the technique should be abbreviated in a degree consistent with the best interests of the case. As, for instance, if the open ends of a diverticulum be brought out through the abdominal wound and fastened, instead of closed, valuable time will be saved.



Fig. 915.—Strangulation of a loop of small intestine by a long ligamentous band.

*The After-treatment.*—The after-treatment in operations for relief of the various causes of intestinal obstruction differs in no essential regard from that commended for all severe abdominal operations. The patient is placed on the back with the limbs in a flexed position, and kept there for three or four days at least. The bladder is evacuated with a catheter, if necessary, at regular intervals; a very small amount of milk and Vichy or of koumiss is given daily after the first twenty-four hours for the first week. Nutrient enemata, and rectal injections for thirst, are sparingly administered during the same time. If intestinal distention occur and become annoying, the rectal tube can be introduced high up at intervals, and allowed to remain for a time. Codein or a small amount of morphin can be administered occasionally to lessen pain and nervous irritation. The bowels should be encouraged to move voluntarily rather than from the effect of cathartics; rectal enemata when discreetly employed answer the purpose well.

*The Results.*—In cœliotomy for acute intestinal obstruction, 68.9 per cent die, and the mortality is twenty-five per cent greater without than with the removal of the obstruction. The death-rate following a complete technique (suturing the bowel) is the highest of any plan of action, being 86.6 per cent (Curtis). The earlier the operation the more favorable is the outlook.

**Colectomy.**—The term colectomy expresses the excision of a limited portion of the colon and the union of the divided extremities. It seems wise, we think, to extend the application of the term to the sigmoid flexure also, rather than employ a new one (sigmoidectomy) definitely applicable to this part of the large intestine, a course not in harmony with the general use of the term colostomy.

*The Operation.*—The operation of colectomy should be performed as early in the history of a case as possible, to secure the best result. After thorough cleansing of the bowel, the incision to reach the ascending or the descending portion of the colon involved is made along the corresponding linea semilunaris, or at its outer side, as circumstances require. The tumor is exposed, and isolated by aseptic surroundings, the contents of the intestine are pushed away from the distal and proximal aspects of the growth, and the bowel is clamped with forceps or tied with gauze at two points about three or four inches apart at each of the respective extremities, the two inner sites of constriction being located close to the growth. The question of the ability to unite the divided ends of the gut should be considered carefully before any impairment of the intestinal structure is made. If the extremities can be united either by end-to-end sewing, by the large circular button of Murphy, or by lateral approximation, without undue tension, the operation is continued by division of the intestine at the proximal side close to the inner point of restraint, and the divided ends are cleansed with carbolic or Thiersch's solution and carefully wrapped in iodoform gauze. The distal portion is treated similarly, after which the two ends are united together by aid of the means best suited to the case. The isolated portion of intestine, along with the growth and secondarily resulting defects, are removed as in resection of the cæcum (page 698), and the wound is cleansed, drained

if need be, and suitably closed. If it be regarded as impossible to unite the divided ends of the colon safely after excision of the growth, either of the following plans can be pursued :

1. Primary anastomosis of the ileum with the colon (ileo-colostomy) at the lowest practicable point beyond the seat of the disease. After this, the disease can be removed or not, as circumstances dictate. If not, the open ends of the bowel are closed and returned to the abdominal cavity, the abdomen is closed and the patient committed to his fate, so far as the morbid growth is concerned. If removal be practiced, it should be done as has already been described.

2. If the distal end of the colon be beyond the reach of the ileum for the purposes of proper anastomosis, either one of two courses can be pursued : (*a*) the closure of the distal end of the colon and the establishment of an artificial anus at the seat of the incision by the withdrawal and fastening outside of the proximal end of the gut ; or (*b*) the closure of both ends of the colon and the anastomosis of the ileum with the descending colon or sigmoid flexure near the rectum. If the plan (*b*) is practiced the sphincter ani should be well stretched to facilitate the discharge of fæcal matter. If stretching is not done the rectal contents are not infrequently carried upward along the colon and small intestine by the expulsive efforts of the bowel, instead of downward as is normal. The writer has had an experience of this kind in an instance of ileo-sigmoid anastomosis.

**Paul's Method.**—In those instances of colectomy in which the formation of an artificial anus is advisable, *Paul* commends the following method of practice : Through a free incision made over the site of the tumor, clean away the adhesions, ligature, and divide the mesentery well beyond the limits of the growth ; remove from the abdomen the loop of bowel and the associated disease ; sew together the divided borders of the mesentery (Fig. 916) and the corresponding adjacent surfaces of the intestine, thus drawing the mesentery outward, so as to lie beneath the bowel ; make an opening into the colon at either side of the disease and introduce into each orifice a large-sized Paul's tube (Fig. 892), ligature it firmly in place, cut away the diseased part, and close the external wound with deep sutures. Two or three weeks later the intestinal spur is, in suitable cases, removed by the enterotome, and the artificial anus closed in the usual way (page 680).

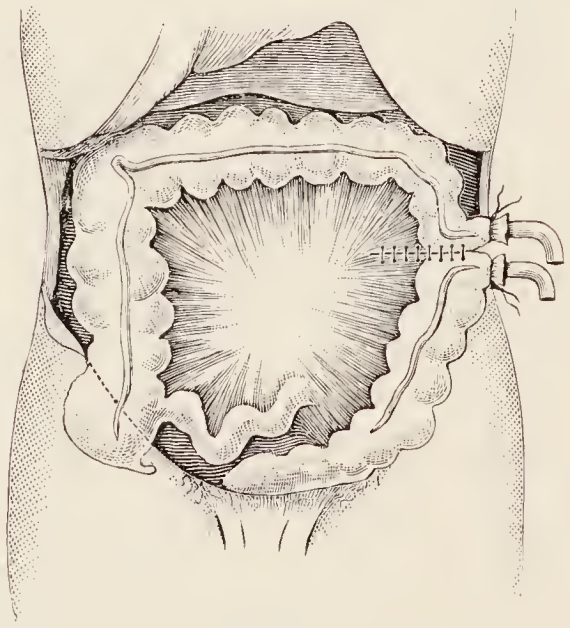


Fig. 916.—Colectomy, Paul's method. Arrangement of bowel to form spur.

*The Remarks.*—Gauze packing, to prevent infection of the wound after operation, is required. The proximal tube is quite sufficient when attended with closure of the distal end, which closure is accomplished independently or by inclusion in the proximal ligature. *Cripps* strongly approves of the removal of the diseased coil of intestine outside of the abdomen, and

its retention there until adhesions have shut off the peritoneal cavity when resected. *Bloch* practices a similar method in three operations: 1, the diseased loop is fastened outside the abdomen; 2, resection and enterorrhaphy are practiced; 3, later the adhesions are separated and the bowel is returned to the abdomen. If the obstruction is acute, an opening into the proximal aspect of the bowel can be made so soon as protective measures are taken.

*Treves, in idiopathic dilatation of the colon*, in a child about six years of age, carried into effect in 1897 * the following measures, which, because of their value, we will freely quote:

"I performed laparotomy on January 13, 1897, opening the abdomen in the median line below the umbilicus. There immediately presented a gigantic coil of colon which looked and felt like the adult stomach, and which appeared to fill up the whole of the abdomen. This coil was at once emptied of its gas through a small incision. The wall of this intestine was smooth and much thickened by hypertrophy, and the actual diameter of the collapsed loop was eight inches. It was this coil which had practically alone caused the distention of the abdomen. Further examination showed that the lower part of the bowel corresponding to the rectum and sigmoid flexure was represented by a straight, solid-looking tube about the size of an adult's forefinger and some eight or nine inches in length. This tube was without sacculation, and its longitudinal muscular coat was very marked. It was of uniform diameter. It was provided throughout with a short mesocolon. There was scarcely a trace of fat within the abdomen, and as a result the blood-vessels of the intestine were easily identified. The junction between the dilated gut and the narrow tube was quite abrupt. I enlarged the little opening I had made into the colon and introduced the finger to examine the interior of the great pouch. Its walls were smooth, and a flaplike fold of mucous membrane occupied the orifice that led into the narrow tube. This opening readily took the forefinger. The fold of mucous membrane may have contributed to certain of the obstructive attacks and may explain the retention of certain enemata. In examining the parts, however, it appeared more probable that the attacks of obstruction would be due to bending or kinking of the bowel at the point where the tube and the great sac joined. The length of the narrowed part of the bowel corresponded to the length of tube which experience had shown was necessary to produce any emptying of the great pouch. The even contraction of the lower part of the bowel may have been in some degree due to the constant use of this tube. I passed a gum-elastic tube of large caliber through the anus and along the narrowed rectum well into the interior of the dilated bowel. The tube measured twelve inches. I had some hope that if it would be kept in position for some time the distention would be relieved and a more normal action of the bowels would be possible. I closed the opening I had made into the descending colon, but brought the suture line into the center of the parietal wound so that an artificial anus could be established at any moment. This fixing of the bowel would, I hoped, tend to prevent it from becoming kinked

* The Lancet, January 29, 1898.

or bent. The wound in the parietes was then closed in all but its central parts.

"For some days the abdomen remained free from distention and the child from pain. Some fæcal matter was passed, but the tube became blocked and could not be freed; another tube could not be properly introduced, the child felt the worry of a foreign body in the bowel, and at the end of seven days the use of the tube was abandoned and an artificial anus established in the center of the median wound. Through this artificial opening all the motions were passed for the next nine months. Practically nothing came by the rectum. The distention was relieved and the child was free from the continued spasmodic pains. There was, however, some difficulty in keeping the artificial anus open, as there always is with such openings when made as the present one was made. This necessitated the introduction for so many hours each day of a bent rubber tube, which kept the orifice quite patent but which occasioned the child a good deal of distress. In October, 1897, I resolved to attempt the excision of the colon from the splenic flexure to the anus, as this appeared to afford the only possible prospect of giving complete relief to what was still a distressing condition.

"The second operation was performed on October 29th. By means of an elliptical incision in the skin I isolated and removed the artificial anus, entering the abdomen on each side of the opening. The orifice in the colon I closed by a series of substantial sutures. I found that the gut, which had at one time been so enormously distended, was now of more moderate dimensions, and its point of juncture with the narrow tube which represented the lower part of the colon was still abrupt. The narrowed tube had shortened somewhat as the result of removing the distention. The dilatation of the colon extended up to the splenic flexure. Beyond that point the colon was practically normal, although it had evidently been to some degree distended and still showed some hypertrophy of its walls. The colon on the right side was normal, and the whole of the greater bowel had a very free mesocolon. Having found that I could bring the left extremity of the transverse colon to the anus, I isolated and ligatured the left colic artery, and having clamped the bowel divided it at the splenic flexure. I then isolated the sigmoid artery and the superior hæmorrhoidal vessels and ligatured them. The absence of fat in the retroperitoneal tissue rendered this proceeding very simple. At the same time I ascertained that the distribution of the middle and right colic arteries was normal. I then excised the gut representing the descending colon, the sigmoid flexure, and the upper part of the rectum. I divided the bowel low down in the pelvis below the entrance of the superior hæmorrhoidal artery. A few bleeding points made manifest by the excision required ligatures. The child was now placed in the lithotomy position, and having made an elliptical incision around the evidently narrowed anus I proceeded to remove the anus together with the lower and remaining portion of the rectum. The separation of the rectum from the slender vagina was a somewhat tedious matter. The middle hæmorrhoidal vessels were secured and the lower end of the rectum removed without difficulty. I returned to

the abdominal cavity and brought the transverse colon down to the anus, where I secured it by a series of close sutures. The gut was conducted into position by four pressure forceps which were passed into the abdomen through the hole in the perinæum. The operation was concluded by closing the wound in the abdomen without drainage. The child made a speedy and excellent recovery. The only complication was represented by some suppuration between the new rectum and the vagina. This was no doubt due to accidental infection of the tissues while drawing the transverse colon into place. As soon as the child began to run about again this discharge ceased entirely." *The results* (Butlin) of operation on sigmoid in 64 cases, 26 deaths. The death rate of sexes about equal. Suture, end to end, 21 cases, 6 deaths; suture, lateral, 1 case, no death. Maunsell's method, 2 cases, no death. Artificial anus, secondary resection, 3 cases, 1 death. Murphy's button, 3 cases, 3 deaths. Block's method, 2 cases, no death.

**Operations on the transverse colon** are made through a median incision, and have a more serious outlook than those of the remaining parts of the large intestine, because of the commanding relation of this portion of the bowel to the peritoneal cavity, and its intimate connection with the peritonæum itself. Infection here invites general disaster, because of the serous environments and their direct relation to the peritoneal cavity at large. However, the ample serous covering of the intestine yields two advantages: the opportunity for free manipulation and for prompt serous union.

*The Comments.*—Care should be taken to bring serous membrane in contact around the entire circumference of the colon along the line of union, in order to secure prompt and serviceable attachment of the divided extremities. The point of exit of drainage in ascending or descending colectomy can be so located posteriorly as to be dependent and substantially outside of the peritoneal cavity. *The results* (Butlin) in transverse colon and hepatic and splenic flexures operations in 82 cases, 29 deaths; death rate much less in females than males. Suture, end to end, 53 cases, 22 deaths; suture, lateral, 2 cases, no death. Maunsell's method, 1 case, no death. Artificial anus, secondary resection, 4 cases, 1 death. Murphy's button, 6 cases, 2 deaths.

**Resection of the Ileo-Cæcum.**—The resection of this part of the intestinal canal is practiced for the cure of malignant disease, and the earlier the attempt is made the brighter will be the outlook. Deferment of operation until symptoms of obstruction appear ought not to be contemplated for a moment, since this course offers no advantages, but profoundly deepens every serious aspect of the case. More or less of the ascending colon is removed.

*The Operation.*—After thorough cleansing of the bowel and the operation field, place the patient on the back and make an incision about five inches in length, beginning in the line of the anterior border of the axilla, at a point midway between the lower border of the costal cartilages and the crest of the ilium, carry it downward to within an inch and a half of the anterior superior spinous process of the ilium, and thence obliquely forward and downward an inch and a half above, and parallel with, Poupart's ligament to a point opposite the middle of this ligament. The tissues of the abdominal wall are divided in consecutive order, the abdominal cavity is

opened, and the borders of the wound are drawn apart by means of retraction sutures. Remove adherent omentum by division between tightened ligatures, expose the lowermost part of the ileum and its junction with the colon; strip aside the contents of the lower four inches of the sound ileum with the thumbs and fingers, and raise this portion of intestine from the abdomen; isolate it with moist antiseptic sponges, and constrict the extremities of the emptied part with clamps or iodoform gauze passed around the gut through the mesentery and tied; divide the intestine close to the seat of the innermost constriction; cleanse the divided ends of the intestine with Thiersch's fluid or carbolic-acid solution, and surround them with iodoform gauze. Then expose for four inches the ascending colon, strip away its contents, and constrict, raise up, isolate, and finally divide it in the same manner as the ileum; unite the divided ends of the colon and ileum directly by Maunsell's (Fig. 806), the oblique end-to-end sewing method (Fig. 917), or, after closure of both ends, by lateral approximation (page 646 *et seq.*), or by lateral implantation of the ileum into the closed (or open) end of the colon (page 649). The distal temporary constricting agents are now removed, and as the fæcal flow is allowed to pass along the newly made channel the operator should determine that no leakage is present. The parts are carefully cleansed and restored to the proper position. If the condition of the patient will permit, the patient is rolled somewhat to the opposite side and the resected part is isolated with aseptic surroundings. Small sections of the mesentery, including the vessels, are then tied with silk ligatures, the mesentery is severed with scissors, and the segment removed. If the patient's condition forbids this course, the constricted ends of the part are brought out into the abdominal wound and fastened to await a more favorable time for removal. In either instance of removal, infiltrated structures and enlarged mesenteric glands should always be taken away when practicable.

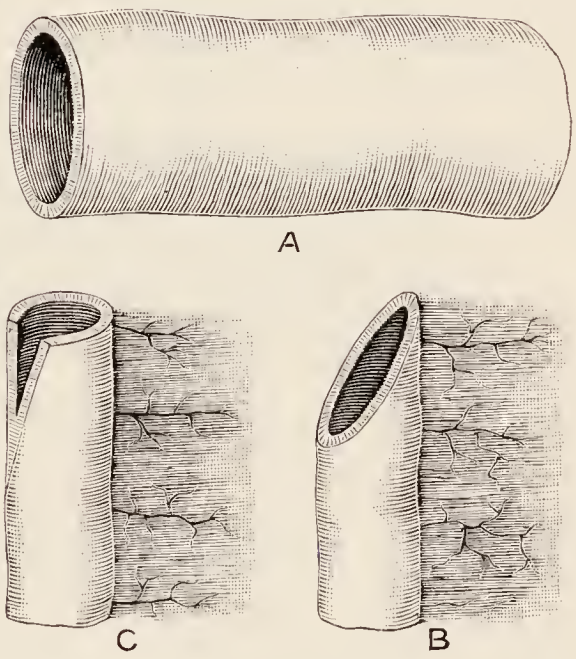



Fig. 917.—Oblique end-to-end sewing of unequal segments. A. Colon. B. Ileum obliquely divided for union with end of colon. C. Longitudinal division, with or without trimming of borders, for the same purpose.

*The Remarks.*—The abdominal incision should be extended promptly in either direction if a too limited extent interferes with inspection or proper manipulation. Denuded surfaces in contact with serous membrane should be repaired with peritonæum by transplantation, or by sewing together the serous borders of the denuded area if feasible. The possible technical requirements arising from the local and general demands of a case should be anticipated, in order that they may be promptly and wisely met without impairing the chances of relief. In the instance of small tumors giving a chance for easy inspection of the mesocolon at either side, this structure may be divided between ligatures and the vessels secured, thus liberating the part before the intestine is removed.

*The Precautions.*—If the growth be adherent to the abdominal wall at the line of incision it will be freely cut, unless the anatomical structures in front be recognized as they are divided. If the tumor be thus adherent, it is better to extend the incision above or below to a point of non-adherence, and approach and separate the growth from the wall with the fingers, rather than to attempt to dissect the adhesions apart in the direct line of approach. Careful scrutiny of the line of intestinal sewing should be made, for evident reasons, and any defect must be promptly repaired. Omental grafting (Fig. 888), to cover a defect, can be practiced, and gauze packing around the line of junction should always be inserted and permitted to remain three or four days, unless the abdominal wound be sooner closed (Fig. 918). *The results* (Butlin) in removal of cæcum and ascending colon, of 95 cases, 29 deaths, 20 per cent better in females than males. Suture, end to end, 51 cases, 21 deaths; suture, lateral, 5 cases, 1 death. Artificial anus, secondary resection, 9 cases, 2 deaths. Murphy's button, 7 cases, 2 deaths. Senn's plates, 3 cases, 1 death. Maunsell's, Paul's, and Mayo-Robson's method, each 1. Paul's died.

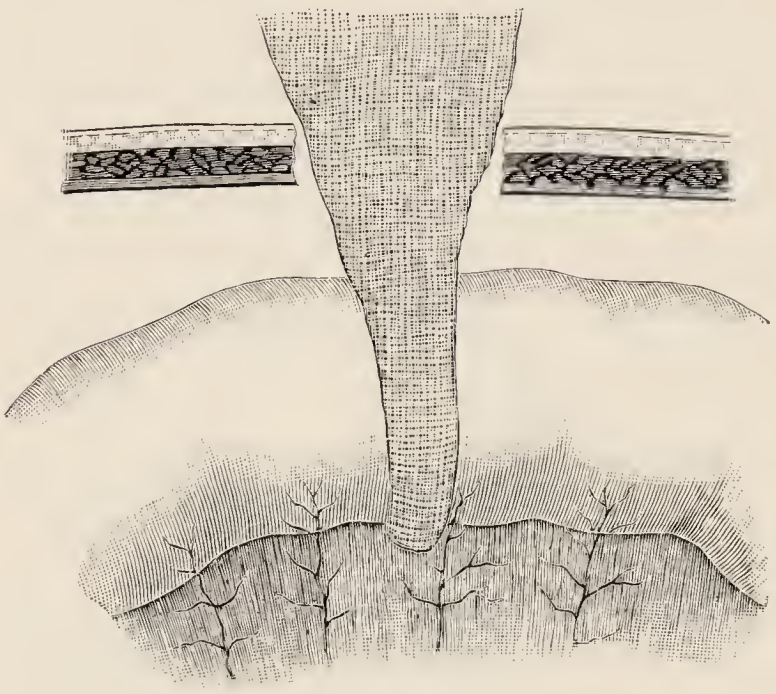


FIG. 918.—Protective gauze packing at the seat of defective intestinal union.

**The Removal of the Vermiform Appendix.**—The removal of the vermiform appendix for relief from manifestations formerly regarded as due to typhlitis is a modern procedure and the product of the genius of American surgeons. The diagnosis of appendicitis and the technique of the operation for its relief are matters of such general medical and surgical attainment now that prompt and effective treatment should be a part of the medical history of every community.

*The Anatomical Points.*—The appendix varies in its origin, direction, size, nature of the contents, etc., sufficiently to warrant a little delay in order that the surgical importance of these variations can be given consideration. In the majority of instances the appendix arises from the cæcum at a point about an inch below the ileo-cæcal junction posteriorly. There are *two good guides* to the location of the base of the appendix, a superficial and a deep one. The former is known as "McBurney's point," and is located as

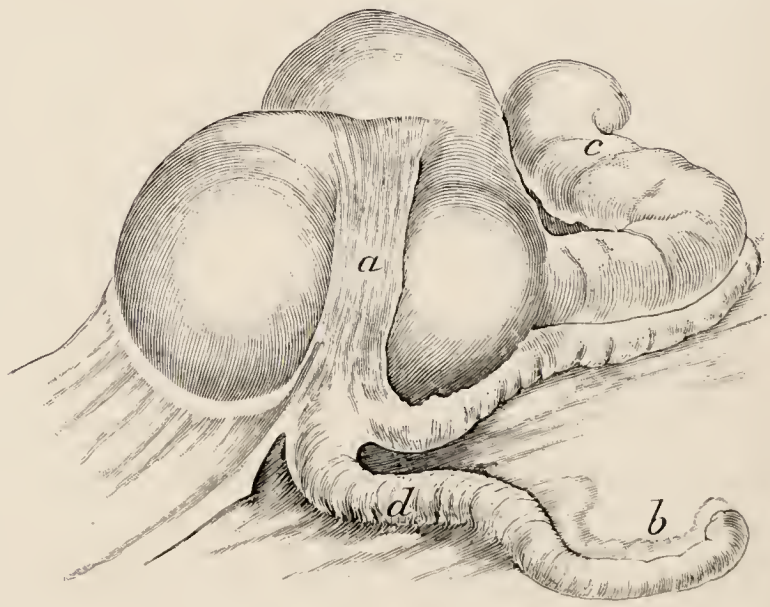



FIG. 919.—The cæcum and appendix. *a*. Fibrous band. *b*. "Free" portion of appendix. *c*. Ileum. *d*. Subperitoneal portion of appendix.

near as may be—about two inches internally—to the anterior superior spinous process of the ilium and on the imaginary line (Fig. 923, *a*, *) extending between it and the umbilicus. It is proper to say, however, that the relation of this point to the anterior superior spinous process, when indicated on the surface, will depend entirely on the location of the part of the surface to which the pressure is applied and the direction of its application. Therefore, some say that it is located midway between the spine and the umbilicus, and others at different situations. The latter guide is the fibrous band (Fig. 919, *a*) that characterizes the cæcum and large intestine, and arises at the base of the appendix. As has been shown by the author already, founded on the examination of one hundred and forty-four post-mortem cases, the appendix extended inward in twenty-four per cent, was behind the cæcum in twenty, and entered the pelvic cavity in fourteen per cent of the cases, and in each instance this position was twice as frequent in the male as in the

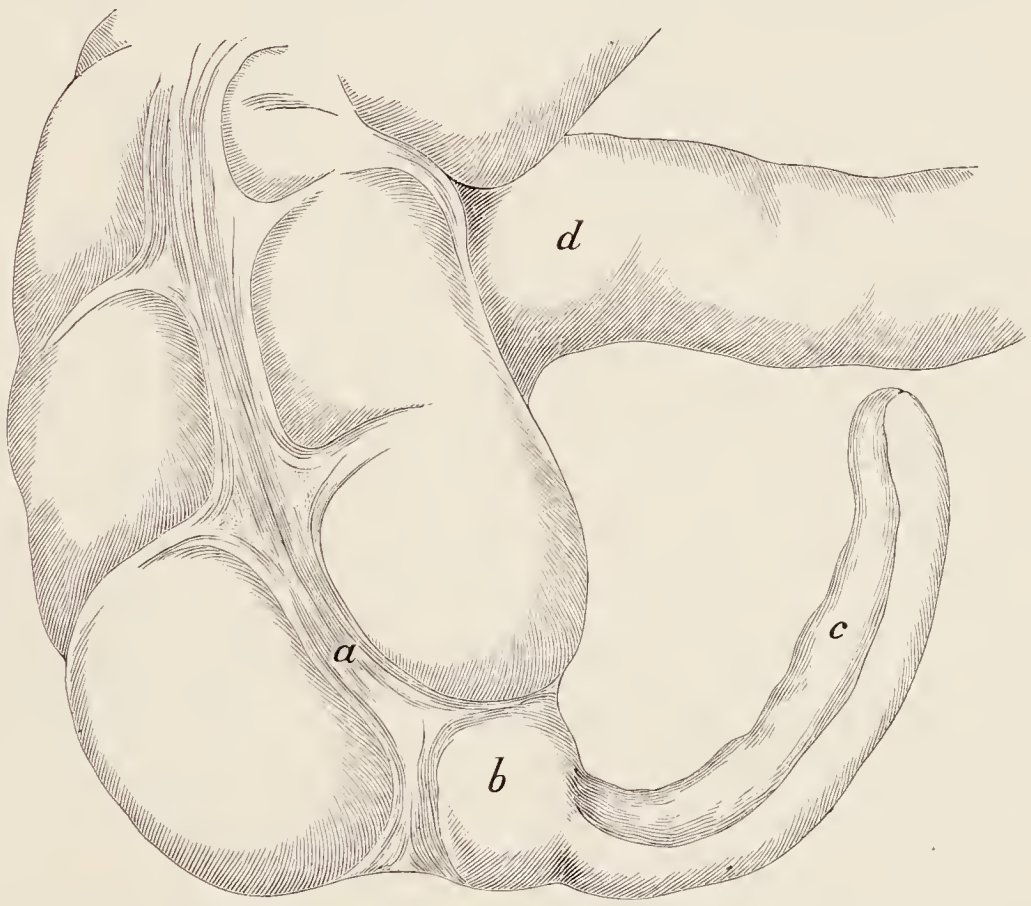



FIG. 920.—The cæcum and appendix (fœtal type). *a*. Fibrous band. *b*. Base of appendix. *c*. Meso-appendix. *d*. Ileum.

female, because of the greater length of the appendix of the former. In the remaining instances the directions were upward, behind, or to the outer side of the cæcum, upward behind the colon, downward, or in other directions closely related to the preceding. But enough has been stated already to establish the fact that the position of the appendix varies greatly, and indeed the local manifestations of a diseased appendix depend much on the position it occupies. Little need be said of the size except as bearing on its relation to the contents and the localization of the organ by abdominal palpation. In forty cases measured, irrespective of sex, eighty-nine per cent were five sixteenths of an inch in diameter and contained fæcal or other foreign material. The remainder were of a less diameter and contained less frequently foreign matters. In some instances we have been able to locate the appendix in the living by abdominal palpation in the absence

of pain and tenderness. However, when the variations in location, direction, and size of the organ are noted, it is not strange at all that it is so frequently undetected; and, too, since the increase in size is in direct proportion to the amount of abnormal contents, should not, indeed, the advantages to be gained be thoughtfully compared with the dangers incurred by manipulation before the attempt is made? In sixty-seven per cent of the cases (one hundred and twenty-four) the appendix contained abnormal material, which was seen in fourteen per cent more of the male than of the female sex. The mesentery of the appendix varied much in extent and area. In forty per cent half or less of the length of the appendix was surrounded with peritonæum (*b*), or "free," as the expression goes, and for this reason possessed a greater power for evil when diseased. Cæca differ in their types (Fig. 920). The situation of the right linea semilunaris should be fixed, not only that it may be divided if need be, but also to prevent, if not desirable, entrance to the sheath of the rectus muscle. The relative direction of the fibers of the respective structures that overlie the cæcum should be carefully noted, also its relation to contiguous vascular, nervous, and other structures (Fig. 921), not only to enable one to recognize the structures in proper order, but also to facilitate an intelligent separation of their fibers should circumstances require it.




FIG. 921.—Transverse section through pelvis at the level of anterior superior spinous process and sacro-vertebral angle. *a*. Dotted line, indicating peritonæum. *b*. Transversalis fascia. *c*. Aponeurosis of external oblique. *d*. Iliac fascia. *e*. Psoas parvus. *f*. Post-peritoneal connective tissue. *g*. Anterior crural nerve. *h*. External iliac artery. *i*. Iliac veins. *j*. Internal iliac artery. *k*. Sacro-iliac junction. These relations are important in estimating the influence of the situation of the appendix on the symptoms, signs, and complications in disease of the organ.

For the purposes of operative treatment of appendicitis five classes of cases are considered, the arrangements of which are suggested by the relations noted to exist between their respective histories and the conditions revealed by operation, together with their relative danger to life:

1. Acute appendicitis characterized by sudden perforation and diffuse septic peritonitis.

2. Subacute appendicitis of insidious development usually complicated with perforation, attended with more or less circumscribed suppuration, and

possibly by phlebitis, abscess of the liver, subphrenic abscess, abscess in the pelvis, etc.

3. Acute appendicitis with perforation and circumscribed suppurative peritonitis.

4. Recurrent and relapsing appendicitis, with varying intervals of attack

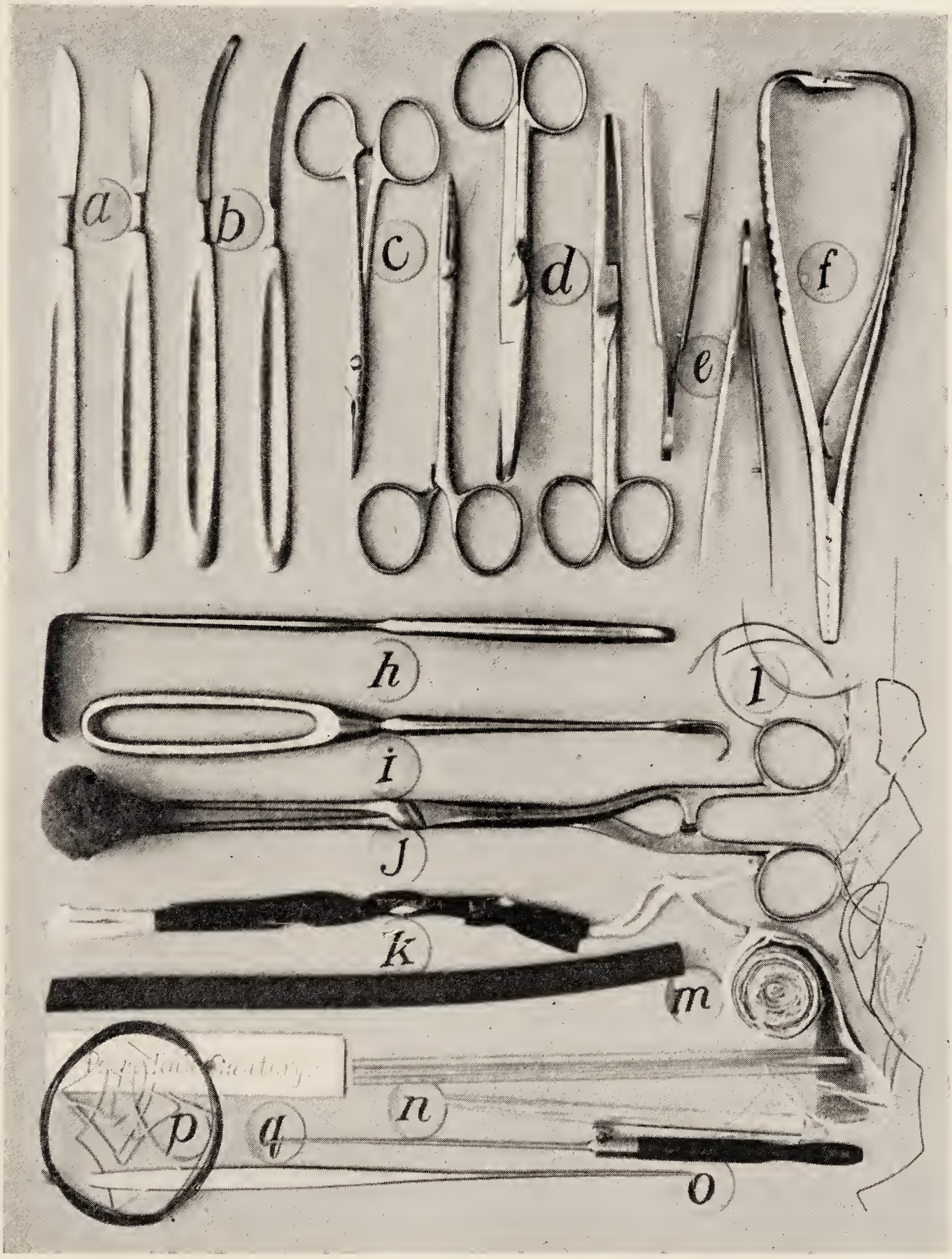
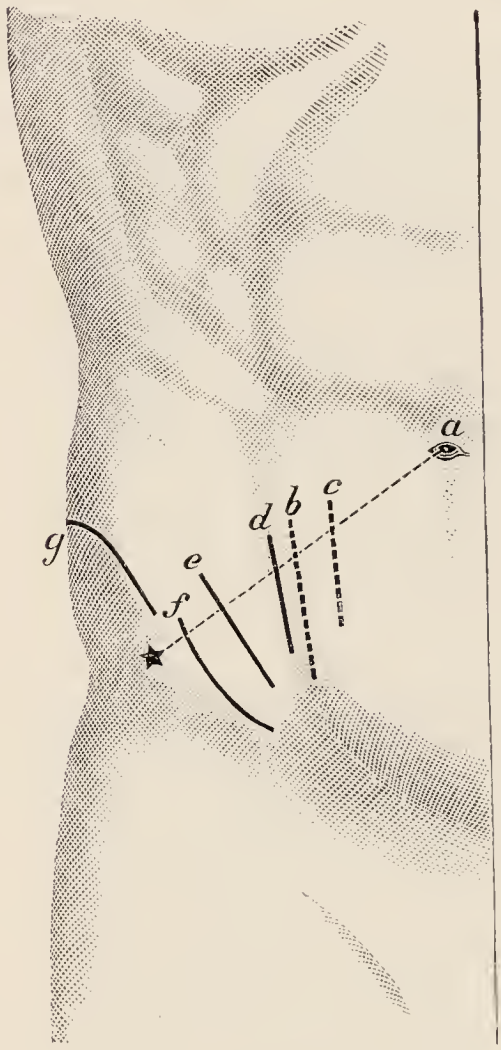



FIG. 922.—Instruments employed in operation for appendicitis.

*a*. Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Curved and straight scissors. *e*. Thumb forceps. *f*. Needle-holder. *h*. Retractors. *i*. Sponge-holder. *j*. Wicking surrounded by fenestrated rubber tissue, for drainage. *k*. Rubber drainage tube. *l*. Needles, sutures, and traction loops. *m*. Gauze for drainage. *n*. Glass tubes, for rinsing and drainage. *o*. Tenaculum. *p*. Catgut and silk ligatures. *q*. Steel probe, to determine patency of lumen with cæcum, and to cauterize the mucous membrane of the stump. Broad retractors and Paquelin's cautery are often much needed.

which unfit the patient for the duties of life; these cases not infrequently terminate fatally.

5. Acute catarrhal appendicitis with or without involvement of the walls of the appendix and with plastic inflammation.



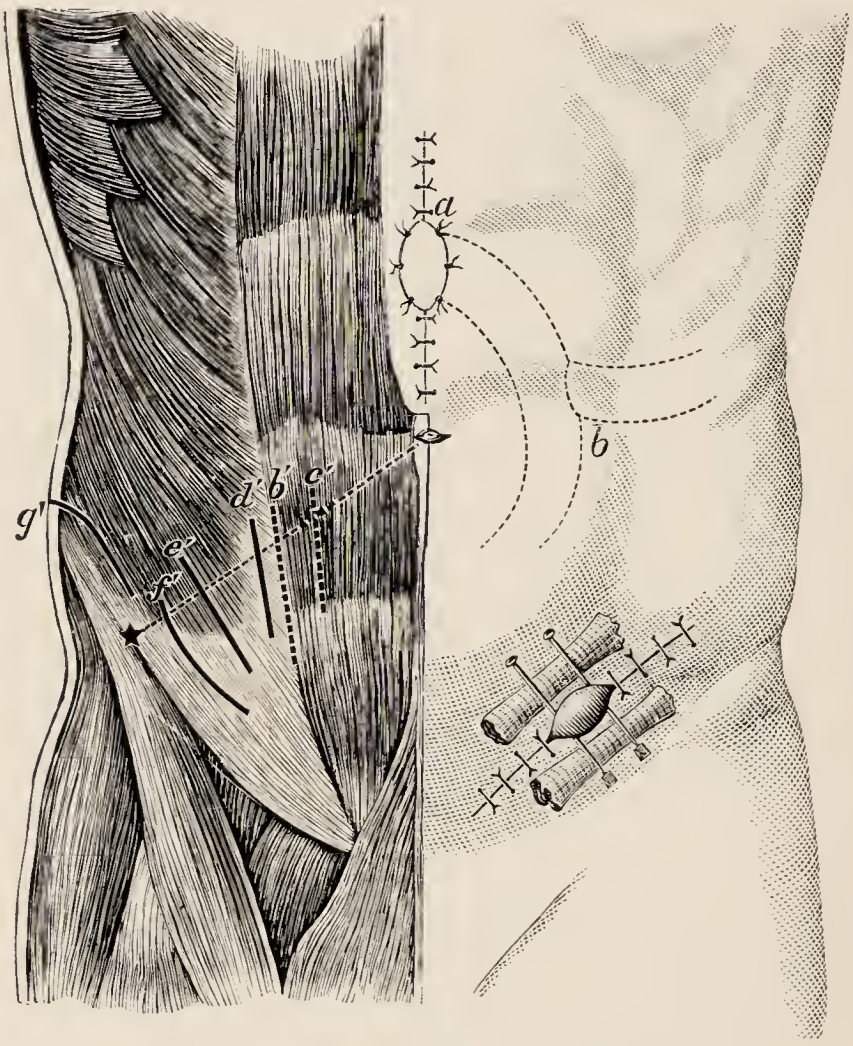




Fig. 923. Fig. 924.

Fig. 923.—The superficial incisions. *a*, *. Imaginary line between anterior superior spinous process and umbilicus. *b*, *c*. Lines of incision in the Battle-Kammerer-Jalaguier method. *d*. Vertical incision. *e*. McBurney incision. *f*. Hypogastric incision. *g*. Vischer's incision. Other incisions are omitted to avoid confusion, but some of them will be described in the text.

Fig. 924.—The deep incisions and their muscular and aponeurotic relations. *a*, *. Imaginary line between anterior superior spinous process and umbilicus. *b'*, *c'*. The Battle-Kammerer-Jalaguier method. *d'*. The vertical incision method. *e'*. The McBurney (gridiron) method. *f'*. The hypogastric method. *g'*. Vischer's method. Ileo-colostomy shown at the left. *a*, *b*. Maydl's method of jejunostomy (page 766).

*The operative technique* of appendicitis demands the application of the rules of asepsis in a most rigorous manner. The operation field, as well as everything brought in contact with the wound and employed in the operation itself, must be made thoroughly aseptic with painstaking care. Abundant hot saline solution, ample sponges and aseptic cloths, iodoform gauze, and drainage agents should be provided. Stimulating agents for the immediate and remoter treatment of shock are needed. In the absence of the stereotyped operating table of hospital life, the extemporized one of humble station or urgent demand will fulfill adequately the necessary requirements of the occasion (Fig. 50). A table allowing postural changes of the patient may be of advantage in the examination of the pelvic cavity to expose the presence of diseased action or products, but it is not indispensable.

*The Incisions.*—The primary incisions (Fig. 923) are mainly located on the right side between the linea semilunaris at the inner and the iliac spine and Poupart's ligament at the outer limit. Differently directed incisions are advised in this operation: the vertical and the oblique are the ones usually employed. Each of these incisions begins about an inch above a line extending from the anterior superior spine of the ilium to the umbilicus; each is made about three inches in length at the outset and is modified thereafter as may be advisable. The oblique intermuscular ("gridiron") dissection and the oblique free division (page 720) of the tissues at substantially the same location are employed; the latter less frequently than formerly, because of hernial sequels which happened in about five per cent of the cases (Fig. 924). The vertical incision is made through the outer margin of the linea semilunaris, and preferably involving the terminations of the transverse muscular fibers at this situation.

*The Remarks.*—The careful union and prompt repair of the divided ends of the muscles and of the separated borders of bundles of this tissue are followed by as firm and often by securer union than that of divided aponeurotic structure. The location, direction, and extent of a primary incision should be regulated much more by the seat of disease and the prospective utility of the incision than by a stereotyped rule of practice. A healthy appendix, or one but slightly diseased and non-adherent, can readily be removed through an incision an inch or two in length, but in reverse conditions the length of the opening should always correspond with the demands of safe practice. The oblique intramuscular separation ($e'$) exposes the patient to the minimum danger of hernial sequels, the vertical ($d'$) and the free oblique to the maximum. The modified methods of approach to the seat of disease will be considered as the conditions demanding their adoption appear.

*The Treatment of the Appendix.*—The appendix should always be removed when consistent with the welfare of the patient. If adherent, it should be cautiously separated from its connections, from the base downward or apex upward, as convenience and care may dictate, observing that no portion of it remains behind. Its mesentery should be tied with catgut in one or more sections, then divided with scissors, and the appendix, raised up along with the wall of the cæcum into the wound, isolated by aseptic surroundings, and perhaps caught with forceps or loosely with a ligature, close at the base (Fig. 925), should be cut off about half an inch from its origin and a sleeve of serous membrane turned

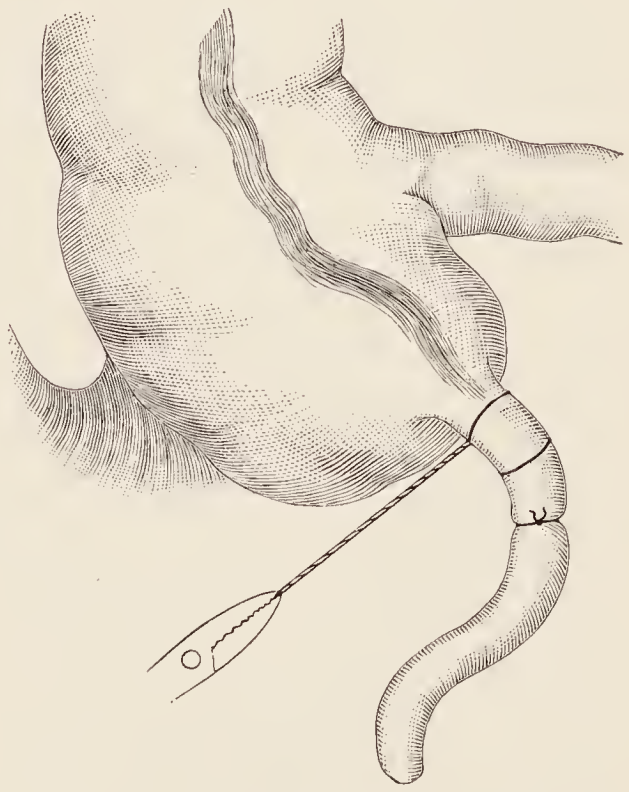


FIG. 925.—Fowler's treatment of appendix, showing base caught by ligature, distal ligature to prevent escape of contents, and line indicating division of the mucous membrane.

up (Fig. 926). The patency of the lumen of the stump is then established before the ligature is applied by the introduction through it into the cæcum of a probe (Fig. 922, *q*). The stump may be treated by one of the following methods:

*a.* By drawing the serous coat over the ends of the inner structures and uniting it there with fine silk or catgut.

*b.* By suturing together the outer and middle coats after removal of the inner (mucous) by cutting or cautery.

*c.* By depressing a short, flexible stump into the wall of the cæcum (Fig. 927) and burying it there by joining together with sutures the borders of the cæcal depression (Fig. 928).

*d.* By severing the stump close to the cæcum, inverting the borders and uniting them as before with sutures.

*e.* By destroying the mucous lining of the stump with cautery, and ligaturing it with catgut "within the cauterized area." After which the end is reduced to small proportions by trimming and cauterization (McBurney).

*f.* By first depositing around the stump, near its base, a purse-string suture going through the superficial tissues of the cæcum, leaving it untied. Then cut off the appendix half an inch from the base, stretch the lumen by the introduction into it, and the separation of the

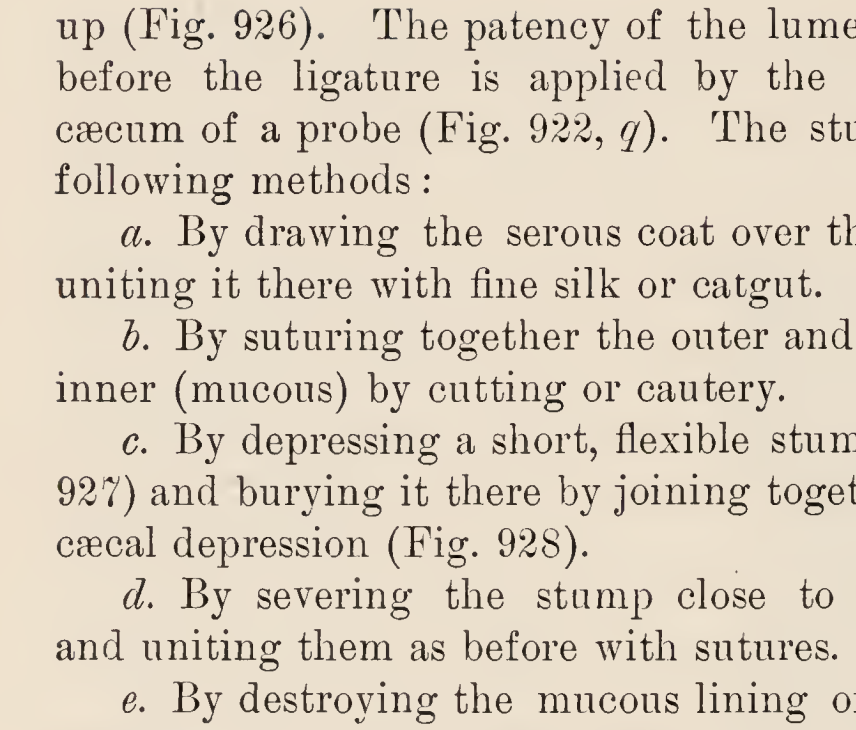


Fig. 926.

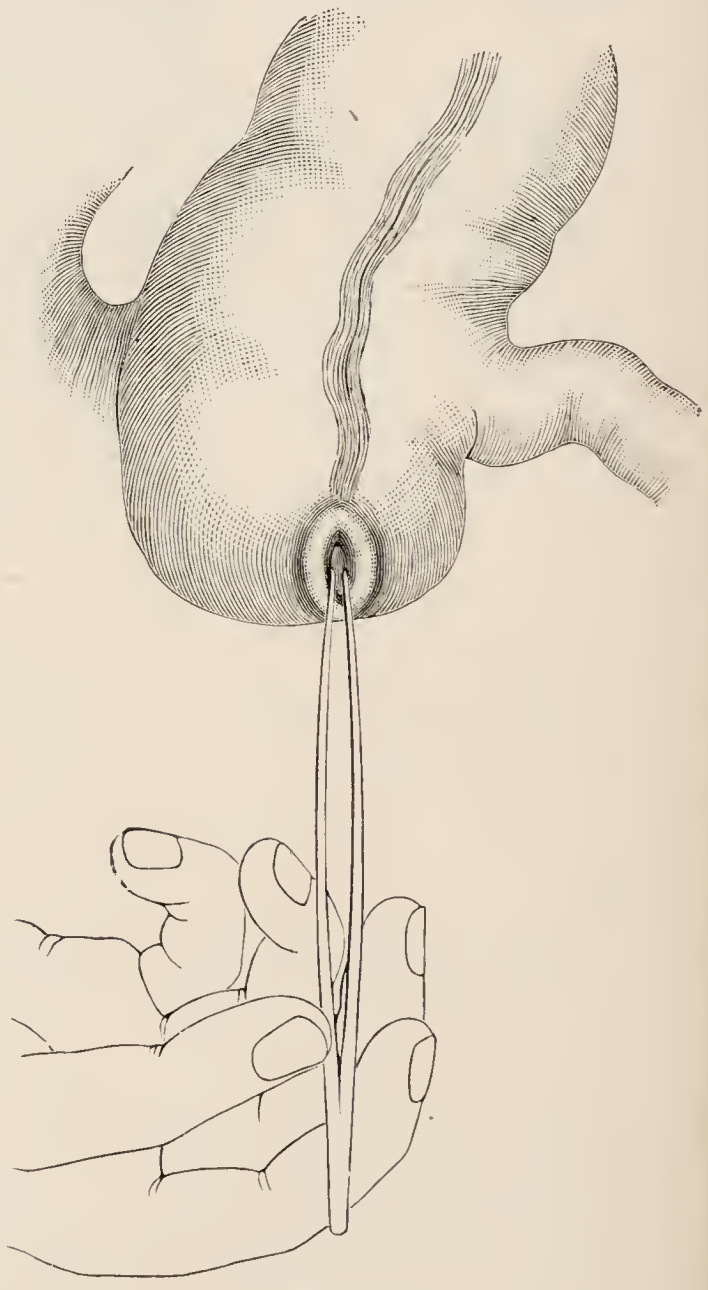


Fig. 927.

Fig. 926.—Fowler's treatment of appendix, showing serous sleeve turned up and end of stump tied.

Fig. 927.—Fowler's treatment of appendix, showing stump buried in wall of cæcum.

blades, of fine forceps; invaginate the stretched tissues into the cæcum with forceps, and hold them there while the suture is being tied (Dawbarn).

*g.* By applying to the base of the appendix, a quarter of an inch from its cæcal origin, a provisional catgut ligature. Isolate the appendix with gauze,

and sever it beyond the ligature with scissors; cauterize the lumen and the end of the stump, and apply a second catgut ligature to reinforce the first (McCosh).

*The Remarks.*—The adoption of any particular method of treatment of the appendix is not of as much importance as is the practice that eliminates from the stump and its environments infecting agents and possibilities. It often happens, on account of disease of the appendix at its origin or of the wall of the cæcum near by, that the practice must be made to conform to the principles of safety rather than to imitation of any stereotyped methods.

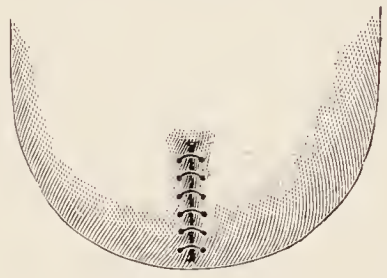


FIG. 928.—Fowler's treatment of appendix, showing sutured borders of cæcal depression.

In suppurative cases, the ligature of the appendix before or after cauterization of the mucous membrane and extremity is quite sufficient. Only durable catgut ligatures should be employed in the infected cases, since silk ligatures under those conditions will invite and may perpetuate the infection. Not infrequently gangrene and other destructive changes at the base of the appendix will render the whole or part of the structure unavailable for the purposes of repair. In such cases as these the utilization of the healthy parts, combined with cæcal inversion and sewing, will answer the purpose. Other modifications of treatment of the appendix will be remarked farther along, as circumstances may require.

**Acute Appendicitis, characterized by Sudden Perforation and Diffuse Septic Peritonitis.**—Through the vertical—made at the outer muscular border (Fig. 923, *d*)—or by an oblique free division (page 713) pass rapidly down to the peritonæum. Arrest hæmorrhage, thoroughly cleanse the operation field and incise the peritonæum, which will not in these cases be adherent to underlying structures. Introduce traction sutures through the entire thickness of both borders of the wound and open the wound wide, preventing at the same time the escape of distended intestines with the hand, or a thin, flat sponge. Wash the field freely with the hot saline solution, sop up the fluid with gauze, and locate the fibrous longitudinal band at the inner aspect of the cæcum (Fig. 920); follow it downward carefully to the base of the appendix, and push aside the intestines and hold them with the fingers or gauze so that the appendix can be located, increasing the external incision, if necessary, enough to permit prompt and free inspection. Raise up the appendix, remove it quickly by one of the simple methods, using cautery if time will permit. As the chief danger in this class is death from sepsis, which has already involved more or less of the peritoneal cavity, and is rapidly spreading, unhindered by adhesive limitation, the proper cleansing and draining of the cavity are the *desiderata*. The site of the appendix and the contiguous tissues are promptly cleansed and fæcal concretions removed. The examination is quickly though cautiously extended inward in various directions in search of collections of fluid, the pelvic cavity and intestinal folds being carefully inspected in this regard. Small, fine sponges on holders, following closely after a carefully advancing finger, are

vigilant agents of discovery and removal of offensive fluids. The variations in the degree of inflammation of the intestine will speak unerringly of the direction and vigor of the disease as the examination progresses. The effective cleansing of the peritoneal cavity (page 612) is very much hindered by the intestinal distention that attends this class of cases; in some, in fact, in which this manifestation is marked, it is very doubtful if even earnest attempts in this line of action meet with a commensurate reward. The forcing between the folds of intestines of fluids that do not promptly return can but increase the extent of the disease. Therefore, we are disposed to believe that eventration in proper cases offers no less chance of relief than forced and ineffective douching of the abdominal cavity. The hot saline solution (115° F.) is poured freely into the opening, and caused to enter the pelvic cavity and pass among the intestinal folds by pushing aside and separating the intestines with the hands. The fluid is thus repeatedly introduced and caused to mingle freely with the intestines by agitation, with the hand in the abdomen and in the cavity, and then permitted to escape by turning the patient on the side until it bears no gross evidence of infection. The patient should then be raised somewhat to cause the fluid to collect in the pelvic cavity, from which it is carefully removed by large, soft, aseptic sponges successively introduced, remembering that frequent or too vigorous sponging causes superficial traumatism of serous surfaces. Careful inspection of intestinal loops, aided by temporary removal of each, and attended with the wiping away of infecting agents therefrom with soft sponges, as well as the absorption of vicarious collections of fluid by the same agents, characterizes the cleansing process. Drainage is a very necessary element of treatment (page 613). The pelvic cavity, the planes beneath and between the intestines, and especially the serous fossæ (page 613) associated with the cæcum, should be carefully drained. The glass drainage tube (Fig. 778) containing gauze is suitable for the pelvis; candle-wicking incased in perforated rubber tissue may be employed instead (Fig. 922, *j*). The latter agent can be wisely employed between the intestinal folds, extended in all necessary directions, and caused to escape at the abdominal opening. Strips of iodoform or of simple gauze can be introduced in a similar manner. Finally, the previous location of the appendix and the wound itself are loosely filled with gauze. The fluid accumulating in the glass tube is withdrawn frequently with a small rubber tube connected with the nozzle of a syringe arranged for the purpose, and kept in an antiseptic solution when not in use. The tube is removed early (page 614 *et seq.*), and a strip of gauze is usually left in its place. The other agents used for drainage are removed as soon as they have served their purpose.

*The Remarks.*—As much as possible of the fluid that may be in the abdominal cavity should be caused to run out through the opening before the saline solution is introduced for flushing, to prevent the dissemination that may attend the act. A perforated rubber or glass tube, carefully guided by the finger, is frequently advantageous in cleansing the *culs-de-sac* that often harbor infection. The leaving behind in the peritoneal cavity, in these cases, of a quart or so of the saline solution is regarded as being

beneficial (page 613). Should vomiting occur, caution is required to prevent the escape of intestine through the drainage opening.

*The Results.*—In this class of cases the operative results are unfavorable, and it is unexpected indeed if recovery takes place when the peritonitis has become general. The fact that an incalculable degree of involvement of the serous membrane is a part of the earliest surgical history makes the prognosis unfavorable at the outset, and emphasizes the advisability of early operative procedure when possible. The outcome is no doubt better than formerly, because of the improved knowledge of their nature and of the salutary influence of free flushing of the peritoneal cavity with hot saline fluid and of efficient drainage. However, the difference in the results reported by equally competent observers suggests strongly the fact of a corresponding difference of understanding regarding the diagnosis of the condition. *The rates* reported vary from total demise to thirty-three and a third per cent recovery.

**Subacute Appendicitis of Insidious Development, usually complicated with Perforation, attended with more or less Circumscribed Suppuration, and possibly by Phlebitis, Abscess of the Liver, Subphrenic Abscess, Abscess in the Pelvis, Etc.**—In the second class the disease is exposed through a vertical or modified incision (page 728), as circumstances require, and the tissues are divided down to the peritonæum. If a pronounced degree of suppuration have taken place beneath the line of incision, and the peritonæum there have become adherent beneath, the deep tissue will be œdematous, the fatty portion presenting a yellow aspect. If fluctuation be felt now, the solution of the problem is easy. However, the elasticity of an adherent intestine should not be mistaken for that of pus, and the remaining tissues must be cautiously divided in any event. If the deeper tissues be but little changed, or not at all, in this regard, a deepening of the incision will quite surely involve the general peritoneal cavity. Therefore, every precaution against the spread of infection, by repression of the intestines and packing of the borders with iodoform gauze, should immediately follow this advancing step. In the former instance, the use of a hypodermic syringe, sharp probe, grooved director, point of the knife or closed scissors can be used to gain an entrance by penetration or friction into the thin-walled cavity. Wipe away promptly the pus as it appears, and enlarge the opening by stretching until the finger can be introduced into the abscess, by means of which the relation of the abscess wall to the abdomen in front can be safely estimated. The opening is then increased in length upward or downward, as the intestinal relations and the pus collections suggest. Draw the lips of the wound apart with traction sutures, and with the finger examine the walls of the abscess for openings or weak points, and the bottom for the presence of foreign bodies. If the abscess be thin-walled at points, or the wall be torn in the manipulation, it should be wiped clean and repaired at once by a careful packing with gauze. Rinse the cavity with the hot saline solution poured from a pitcher but little elevated, the stream being directed or modified in force by the interposition of the hand; separate the deeper walls with the fingers, and wipe away with small, soft sponges the fluid remaining in the cavity. Locate

and remove the appendix, unless its removal may rupture the limiting wall of the abscess at its peritoneal aspect and cause extended infection. And then the appendix can often be divided at the base, the stump treated as in other suppurative cases, and what is practicable removed, the remainder slit up and perhaps curetted, leaving the intramural portion to the care of Nature. In this class of cases, especially, the base of the appendix should be located first in all instances, and its course in the abdomen carefully followed, for along it not infrequently the purulent canal passes up behind the ascending colon to the liver, or into the pelvis, etc., involving large vessels and establishing isolated pus collections. The diversity of the direction of the appendix within the abdomen should be considered in the exploration of these cases (page 709). The external wound must be enlarged, and the walls of the purulent canals and collections separated, carefully examined, and, when necessary, repaired with iodoform gauze and drained, as the examination progresses. If the appendix extend toward the pelvis, it may enter that cavity and perforation occur at the intrapelvic part of the organ, causing pelvic abscess. The careful exploration of the pelvic cavity, with one or more fingers introduced through the vagina or rectum will, in these cases, often elicit the presence of tumor there, attended with pain and tenderness. These pus collections can be reached from the original incision by careful separation of the intestines with the fingers in the course of the appendix, accompanied with simultaneous tunneling of the canal with gauze. The not infrequent practice of blindly fumbling among the intestines for pus with the finger, without gauze fortification, is as dangerous as indelicate, sometimes causing perforation of the intestine, and always heightening the danger to the patient from general peritoneal infection. Not infrequently pelvic abscesses due to appendicitis are opened through the vagina or rectum, especially in depressed cases and those in which the uncertainty as to surgical technique makes this the safer procedure of the two. The appendix is rarely indeed situated extraperitoneally and upward behind the ascending colon (two per cent), as may happen in this class. Under these circumstances, with high perforation and cellular inflammation, the abscess may require opening above the crest of the ilium (Fig. 923, *g*).

*The Remarks.*—If abscess be found in the pelvis it is wiser to approach it through an incision in the median line, or through a modified incision (page 723), than to practice inadequate, harmful, and prolonged manipulative efforts through the primary incision. The author has observed three cases of this class complicated respectively with subphrenic abscess, abscess of the deep tissues of the body, and high perforation of the colon. Presumptively the appendix extended upward, beneath the peritonæum and behind the colon in each instance. It sometimes happens that an appendix of abnormal length and unusual location causes in distant parts of the abdomen symptoms of an acute or subacute nature. For these reasons appendicitis at the left side is not unheard of, and should therefore be regarded possible without transposition of viscera.

*The Results.*—In this class of cases the insidious development in numerous instances and the consequent uncertainty of diagnosis, the latter depend-

ent not infrequently on the unusual length and direction of the appendix, are attended with such doubt and delay in proper treatment as to deprive the patient of the salutary benefits of operative action. Especially is this true when hepatic or venous complications ensue. Fortunately, however, these cases are comparatively rare.

The outcome of appendicitis is less favorable when its manifestations are located in unusual and out-of-the-way places—those which blind diagnostic acumen and hinder proper practice. For these reasons only the final results in cases with pelvic involvement are often less favorable than those of a similar character located nearer to hand.

**Acute Appendicitis with Perforation and Circumscribed Suppurative Peritonitis.**—In the third class the vertical or oblique incisions can be made (Fig. 923). As a general proposition (page 713), best repeated in connection with this class of cases because of their frequency, the incision that affords the best opportunity for exploration and drainage and avoidance of peritoneal infection, with the least liability thereafter to parietal infirmity, should be adopted. Therefore, tumors located near the median line should be incised at their center, either through the ordinary or the modified vertical incision; those nearer the crest of the ilium and along Poupart's ligament at the external aspect (Fig. 923, *f*). Little can be said regarding the treatment of abscess in this class not expressed already in the description of the approach to, and treatment of those of the preceding class. Here, as there, the conditions of the deep tissues of the abdominal wall indicate their relation to suppuration, and suggest like means for the avoidance of infection. The appendix is ligatured with catgut after division and cauterization of the mucous membrane. In some instances the appendix is missing entirely, or sloughing shreddy remnants only attest its past existence. The cavity is cleansed by wiping with soft sponges, aided by gentle flushing with the hot saline solution, or a solution of peroxide of hydrogen. Any defects in the lymph environment that were present at the outset, or that occurred during the cleansing, must be repaired at once with iodoform gauze. Finally, the wound is packed lightly with iodoform gauze, and the whole overlaid with sterilized or bichloride gauze held in place by an abdominal binder. The wound is usually redressed at the end of forty-eight hours. Still, an earlier period may be necessary or a later one suffice, depending on the character and extent of the wound and the local and constitutional manifestations of infection. Visible soiling of the dressings calls for their prompt removal. The wiping out of the wound with soft sponges or pieces of gauze supplemented with peroxide of hydrogen, cleansing of wound recesses, and loose filling with gauze, aided by a constantly increasing tension of the binder to limit the extent of cicatrization, characterizes the local treatment.

*The Remarks.*—These cases are of comparatively common occurrence, and usually the surgical technique can be readily carried into effect. The deep incision into the abscess differs but little from that of common abscesses elsewhere in the body, except when peritoneal adhesion in front is in doubt; then, careful approach is requisite, and cautious packing needed if adhesions

be absent, to avoid further infection. The practice relating to the removal and treatment of the appendix in other cases is applicable to this.

*The Results.*—The operative prognosis is good, provided adhesion between the visceral and parietal peritonæum has taken place, or the spread of infection is prevented by suitable gauze packing in the absence of adhesion before the pus is liberated. The effort to remove the appendix when it is imbedded in the limiting wall of the abscess often provokes extension of the disease without offering a commensurate advantage to the patient (page 718). Determined efforts of this character should not be made except for better reasons than have yet come to the notice of the author. Enucleation from its serous covering is sometimes practiced in these cases. The reported mortality operations in acute cases are misleading, as it rarely happens that the important influences contributing to an unfavorable result appear in the statements. However, the rate in acute cases of all classes is about twenty per cent.

**Recurrent and Relapsing Appendicitis, with Varying Intervals of Attacks which unfit the Patient for the Duties of Life; these Cases not infrequently terminate fatally.**—The cases of this class are comparatively frequent indeed, and their relatively benign character invites prompt action which affords safe relief from established or prospective danger. The appendix may be either entirely free or more or less adherent, and sometimes associated with limited old suppurative changes. The parietal peritonæum is rarely adherent to the subjacent parts, therefore, its division trespasses at once on the general peritoneal territory. *Two methods* of approach are practiced in these cases: one the ordinary (free incision), the other the "grid-iron" method (Figs. 923 and 924, *e* and *e'*). In the former, the respective tissues are divided along the line of an oblique incision carefully down to the peritonæum which is cautiously severed, after which the cæcum is exposed, and the fibrous bands are noted and followed down to the base of the appendix, which with the finger is drawn gently into the wound along with the anterior surface of the cæcum, carefully examined to note its entirety, isolated with aseptic gauze, cut off, and treated according to the method approved by the operator. If the appendix be adherent or involved in old inflammatory processes, as indicated by examination with the fingers, the organ is carefully exposed and the general peritoneal cavity shut out by packing the borders gently with gauze. The appendix is then cautiously disconnected from its adhesive environments—carefully noting that no portion remains behind—raised up, isolated, and removed. In both instances the operation field is cleansed with the hot saline solution, and the wound closed in those cases that present no evidences of present or prospective infection. In the others, the previous location of the appendix and the wound itself are packed loosely with gauze, as in the cases of established infection. If the two layers of peritonæum should happen to be adherent, the main caution consists in gaining the site of the appendix without entering the canal of an interposed intestine. However, if the tissues in turn be accounted for as divided, and the relation of the tissues that immediately underlie the transversalis muscle be noted, and the advance be made slowly through the tissues by friction severance, no pronounced involvement will happen. If the intestine be

opened, the incision should be closed at once by sewing and the operation continued.

*The Remarks.*—The intervals of quiet of recurrent cases, and the paroxysmal manifestations of the relapsing, constitute significant differences in these kinds of appendicitis. Although neither of them is as dangerous as is a primary acute attack, still, either should be regarded important, as it may promptly prove fatal. A second attack occurs in about twenty-one per cent of acute cases. This class of cases is often of a catarrhal nature.

*The Results.*—In the fourth class the prognosis of operation during the attack is much better than in acute appendicitis. If performed in the interval of the attacks the death rate is scarcely two per cent. In fact, the operation at this time exposes the patient to less danger than does the presence in the abdomen of the diseased appendix. The "gridiron" plan is especially applicable to these cases, since the confinement in bed and hernial sequels are reduced to a minimum. It should be remembered, however, that secondary attacks may expose the patient to as great, and even greater danger than did the primary acute one.

*The Gridiron Method* (McBurney).—The gridiron method is indeed a commendable plan of action in those cases which admit of immediate closure of the abdominal wound. It is beneficent in the prevention of the hernial sequels following other common methods of entrance that too often plague the patient and vex the surgeon. The primary incision (Figs. 923 and 924, *e* and *e'*) is made along the oblique line down to the aponeurosis of the external oblique muscle, the fibers of which are separated in the line of their course to the proper extent; each succeeding layer of tissue, as it appears after division of the intermuscular planes of fascia, is treated in the same manner until the fasciæ are reached. The fasciæ and the peritonæum are divided independently in the line of the separated fibers of the transversalis muscle, the appendix is located, raised upward into the wound, and treated as non-infective. The borders of the respective tissues of the wound are united to each other with catgut in the reverse order of separation. Superficial drainage with a few strands of catgut or a similar agent is sometimes employed. The wound is dressed in the usual manner, and the patient kept quiet for twelve to fourteen days. Owing to the different directions of the lines of separation of the tissues, not less than four retractors or retraction sutures are essential to the proper exposure of the underlying structures.

*The Remarks.*—This method of practice is best adapted to non-suppurative cases and those in which the area of diseased action is of a limited extent. However, many surgeons employ this plan in suppurative cases, especially in those of limited extent, in order to gain the benefits for the patient of the greater strength from uncut tissues at the seat of the opening when healing ensues. If the magnitude of the disease be large, or the appendix be of uncommon length or in an unusual position, the opening is often of inadequate size for the purposes of safe and thorough practice. Under these circumstances its extent may be increased by stretching with retractors and by suitable division in the requisite directions of the restricting tissues (page 723). It is proper to say at this time, we think, that the

rule of action relating to the extent of incisions and their relation to proper observation and manipulation of both diseased and healthy structures (page 37) applies in abdominal surgery with greater force, if possible, than to operations elsewhere on the body.

*The Results.*—Inasmuch as this method of procedure is especially applicable to chronic cases and to interval operations, the death rate, though modified, of course, by the experience and skill of the operator, is exceedingly small, varying from *nil* to four or five per cent.

**Acute Catarrhal Appendicitis with or without Involvement of the Wall of the Appendix and with Plastic Exudation.**—The fifth class of cases, especially those characterized by extensive fibrinous exudation, are often attended with unique clinical expressions and an astonishing amount of fibrinous deposit. They are temporarily regarded, not infrequently, as sarcoma of the cæcum. Either the vertical or oblique incision can be employed in this class of cases. If the tumor be not large, the "gridiron" plan of action may be adopted. In the instance of a large deposit, the visceral and parietal layers of the peritonæum will be adherent to each other, and thus shut off at once the general peritoneal cavity from the line of incision. If the amount of exudate be small this adhesion will not happen, and the intestines must be pushed aside and held there with gauze as soon as they appear in the wound. The search for the appendix in the fibrinous mass should be conducted with care to avoid injury of hidden tissues. If the exudate does not involve the cæcum, or can be separated from it, the base of the appendix can be exposed through the guidance of the fibrous band leading to it, and, finally, the entire organ can be enucleated from its firm environment, noting carefully that no part of it remains behind to breed infectious processes. If the new tissue can not be separated from the wall of the cæcum without endangering the integrity of the structure, the deposit should be carefully pried open in the long axis with the handle of a scalpel, beginning at the point of established origin of the appendix. The appendix is then carefully and completely removed, the stump treated according to the nature of the case, and the wound closed if the presence in it of infective agents be not suspected. If infection have been present, the wound in the abdominal wall should be shortened as much as possible with sutures, the remaining wound cavity having first been packed lightly with gauze to the bottom. The fibrinous induration disappears rapidly and completely after the removal of the appendix.

*The Remarks.*—Appendicitis of this nature, while comparatively unusual, happens sufficiently often to frequently perplex the medical attendant regarding its true nature. In more than one instance the tumor on exposure has been mistaken for sarcoma of the cæcum, and the cæcum removed by competent surgeons. The writer recalls a somewhat recent case of this kind in his own practice, in which, owing to the large size of the tumor, the presence of extensive mesenteric glandular involvement, the absence of any local evidence of peritonitis, the feeble state of the patient, and the indefiniteness of the history of the case, inoperable sarcoma of the cæcum was diagnosticated. The abdominal incision was closed, and the patient

made a prompt and complete recovery and is vigorous and healthy at the present time.

*The Results.*—The results from removal of the appendix are excellent, and none other than a favorable outcome need be expected. Rapid final absorption of the plastic material follows, and in fact may follow without removal of the appendix, but is likely soon again to return.

**The Removal of the Appendix during the Interval.**—In 1888 Treves removed the appendix during the interval in a case of relapsing appendicitis. Since that time the wisdom of the plan has become well recognized by the profession, and is now being quite generally practiced. The exact period of time after an attack before operative interference is advisable can not be definitely stated, because of the variations in the degree of the infliction and in the powers of recovery. Therefore each case should be decided upon its own merits, remembering that the completer the recovery the less is the danger, and consequently the simpler and safer is the execution. But since the removal, after practical subsidence of the manifestations of the attack, is safer for the patient than is the retention of a rebellious appendix, the operation should be performed, if possible, before the appearance of another attack. An interval of two or three weeks may be regarded as suitable in the majority of cases.

*The Results.*—The results of operation at this period are almost uniformly successful, it being infrequent, indeed, that death occurs therefrom in the practice of experienced surgery.

**The Modified Incisions.**—Modification of the standard incisions of the abdomen are advised for the purpose of meeting the demands of well-understood and of unanticipated conditions that present during the course of the operation. The gridiron method (Fig. 924) is ideal when the extent of the disease admits of proper treatment. But when for any reason it becomes necessary to enlarge the opening by traction or free division to meet the requirements of proper technique, the muscular structures especially often suffer in an objectionable degree. In such cases additional room can be gained by division upward along the outer border of the rectus muscle (Stimson) of the denser tissues which are united afterward by sewing.

The transverse division of the aponeurosis of the external oblique and the superimposed tissues from a point located half an inch inside of the anterior superior spine of the ilium to the outer border of the rectus muscle is said (Elliot) to afford more room in this method than does the oblique division of these structures. *Weir* gains the needed room by tearing the "denuded fascia" of the external oblique from the sheath of the rectus to near its inner border. He then divides the anterior layer of the sheath transversely to the inner border, in the line of the muscular separation, draws the rectus muscle inward, ligatures the epigastric vessels as they appear in the sheath, cuts the posterior tissue of the sheath and the peritonæum in a line corresponding to the division of the anterior layer. When the borders of the wound are drawn asunder the pelvic cavity can be freely examined. The tissues of the supplementary incision are repaired in the reverse of the order of division. In other respects the wound is treated as heretofore. This measure affords

ample room, with easy and secure repair, and is a valuable adjuvant of the intermuscular separation method.

At about the same time *Battle*, *Kammerer*, and *Jalaguier* each independently proposed a novel method of approach to the appendix through the sheath of the rectus in relapsing cases. The anterior walls of the sheath and the superimposed structures are divided vertically at the outer border of the rectus muscle (Figs. 923 and 924); the tissues at the inner border of the incision, including the rectus muscle, are drawn inward with blunt retractors (Fig. 929), thus exposing the posterior wall of the sheath and the semilunar fold of Douglas; through the posterior wall of the sheath, within half an inch of the outer limit ($c''$), a vertical incision parallel with the preceding one is made into the peritoneal cavity; the borders of this incision are drawn apart, the intestines pushed aside, and the appendix is exposed and removed. The wound is closed in the following manner: The divided borders of the peritonæum, of the fascia, and of the posterior wall of the sheath are united by a single row of continuous or interrupted catgut sutures. The rectus muscle is then permitted to fall into place and the borders of the anterior layer of the sheath and oblique aponeurosis are joined, as in the preceding instance. Finally, the superficial tissues of the wound are united with catgut or silkworm-gut sutures.

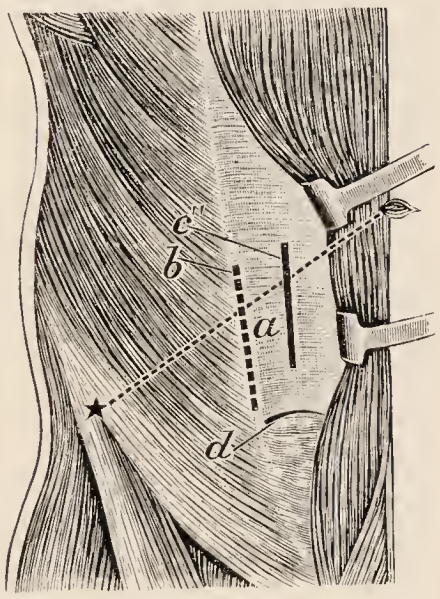



FIG. 929.—Battle-Kammerer-Jalaguier method. *a*. Posterior layer of sheath of rectus. *b*. Indicating line of superficial external incision (*b* and *b'*, Figs. 923 and 924). *c''*. Line of incision through posterior sheath of rectus. *d*. Semilunar fold of Douglas.

*The Remarks.*—By this method of practice the lines of union of the divided tissues are fortified by the presence and function of the unimpaired rectus muscle and the liability of the occurrence of hernia is correspondingly lessened. However, the degree of exposure to injury of the nerves and the epigastric vessels, and the somewhat limited application of the method, together with the disadvantages incident to the possible needs of drainage, counsel the exercise of wise forethought in its selection. This form of incision is well adapted to children.

*In those cases of appendicitis* exhibiting evidences of abscess above the crest of the ilium, always suggestive of the presence of a diseased appendix behind or to the outer side of cæcum and colon, an iliac or lumbo-iliac (Grinda) incision may be utilized. In such cases drainage through the loin should be practiced, even in the event of the employment of a standard incision. The great thickness of the abdominal wall at the loin, and the strong tendency of the opening to close, calls for the introduction of a large-sized firm-walled rubber drainage tube.

*Vischer's incision* is eminently practical in these cases. The external oblique muscle is exposed through a curved incision carried an inch above the crest of the ilium (Fig. 923, *g*). If additional room is needed, the incision can be extended downward to and along Ponpart's ligament. The

fibers of the external oblique are separated (Fig. 924, $g'$), also those of the succeeding muscles down to the fascia, which, along with the peritonæum, are divided vertically, thus promptly reaching the outer aspects of the colon and cæcum. Through this opening the pus will escape, and the appendix can be removed and dependent drainage provided. The danger of hernial sequels is not significant.

*Meyer* advocates an incision which he denominates "the hockey-stick incision." This incision commences at a point half an inch above the imaginary line (Fig. 923, $a$, $*$), and at the junction of the outer with the inner three fourths, passes obliquely downward and inward to a point over the femoral artery, and about three quarters of an inch above Poupart's ligament. The tissues are treated as in the intermuscular method, and the abdomen is opened, when, if additional room is needed, the incision can be extended upward and inward, or curved directly inward to a horizontal plane, as circumstances require, thus forming the "hockey-stick" outline (Fig. 963).

*The Remarks.*—Ordinarily the horizontal limit of the incision ends at the outer border of the rectus, but, if additional room is required at this aspect of the wound, the rectus can be divided to the needed extent to secure it, after ligature of the epigastric vessels. There is much to be said in favor of this incision when the diseased processes are located low in the iliac fossa and invade the pelvic cavity.

*Fowler* exposes the aponeurosis of the external oblique by reflecting a triangular-shaped flap of integument and fascia, the upper border extending transversely between the anterior superior spinous process and the rectus abdominis muscle, and the inner from the termination of the former downward, parallel with the edge of the rectus, two and a half inches or more, as circumstances require. Then expose the external oblique still more by counter traction made from the middle of the upper border and at the lower angle; divide the external oblique structure downward and forward about three or more inches to the border of the rectus sheath; make counter traction at right angles with the preceding, thus exposing a greater area of the wound; make a vertical incision into the outer limit of the sheath of the rectus, two or three inches in length; retract the rectus muscle and the epigastric vessels well toward the median line; retract the outer border of the divided aponeurosis in the opposite direction, thus exposing the internal oblique; divide transversely the internal oblique and transversalis muscles in the course of their fibers, extending, if need be, the incision into the posterior wall of the sheath of the rectus; draw asunder the borders of this incision; divide the fascia and peritonæum on the finger from within outward; expose and remove the appendix in the manner fitting the case; replace and unite the deep parts in position with continuous catgut sutures.

*The Remarks.*—The incised edge of the sheath of the rectus should be carefully closed along with the aponeurosis of the external oblique. No part of the rectus muscle should be included in the sutures. Fowler regards this method as especially applicable to cases with limited impaction. Fowler claims for this method the following:

1. "Ready access is gained to the ileo-cæcal region, and ample room

secured for all necessary manipulation in the class of cases for which it is designed.

2. "Weakening of the abdominal wall and the liability to surgical hernia are reduced to a minimum by (*a*) incising the important musculo-aponeurotic structures in such a manner as to secure immediate, firm, and permanent union; and (*b*) avoiding injury to the vascular and nerve supply of the parts involved in the incisions."

*The General Comments.*—No one method of operative procedure is equally applicable to all cases. Therefore, a careful consideration of the history and the local manifestations of each case should direct the placing of the primary incision, and thereafter it should be modified to meet the demands of present and final security of the patient. Obese patients, and those affected with disease or subjected to unsanitary surroundings, should be approached surgically with caution when feasible, as these agencies often exercise a potent influence opposed to a favorable outcome. After exposure of the parietal peritonæum through the incision, limited or extended palpation, secured by separation of the peritonæum from the fascia at the sides of the wound, can be practiced to determine the characteristics of the growth. If the stump of the appendix be rigid, it is not advisable to make forcible attempts at invagination, since they will likely fail entirely or lead to deception by their incompleteness. Disappearance of the appendix by maceration in the fluids of the disease is more perplexing than strange, since it may lead to useless and unwise search for the diseased organ. Inasmuch as wide and firm packing of the wound provokes delayed and defective repair, impedes drainage, and favors the formation of constricting bands, the gauze dressing should be placed in the wound in an orderly manner and in small amount, so as to encourage drainage and limit as much as possible the production of new tissue. Counter openings for the purpose of the introduction of drainage agents can be wisely employed, when, for any reason, inadequate drainage can not be secured through the primary incision. Extended involvement of the peritoneal cavity and its contents suggests the necessity of establishing counter drainage. The administration of constipating agents, and those calculated to disguise important manifestations of disease, especially opium and its derivatives, should be avoided when justifiable. Saline cathartics are advised to secure early action of the bowels and to obviate constipation. The introduction into the small intestine, through an incision or by means of a syringe, of a solution of magnesium sulphate, as advised by *McCosh*, is commendable, especially in septic cases. Avoid eventration, if possible.

*The Precautions.*—It happens sometimes that the origin of the appendix is not associated with the termination of the fibrous bands of the cæcum, a fact that should be recognized, otherwise unfortunate conclusions might follow the absence of the usual relation of these parts. The rolling outward or inward of the cæcum by the contraction of old adhesions often presents to the judgment of the operator annoying anatomical problems. The ligaturing of the appendix outside the seat of the obstruction of the lumen may afford no relief, and even provoke thereafter a renewal of the attack by the establishment of an unventilated mucous chamber at the distal end of the

stump. The ascertainment of the permeability of the stump by the introduction through it into the cæcum of a probe, and the stretching of it with forceps before final ligature, are each often of signal importance in the technique preventive of recurrence. The burial in the wall of the cæcum of an impermeable or diseased stump of the appendix should be avoided for apparent reasons. In raising the appendix into the wound for removal, a small diseased portion of it may be torn away and remain attached by adhesions to a somewhat distant part. The retained fragment may not only become the source of renewed morbid action, but the ruptured appendix may incite inflammation by infection of the serous surfaces along the line of its withdrawal. A careful examination should therefore be made, to determine the integrity of the appendix before the final technique is completed; and, too, caution should be exercised in exposing and raising it upward for removal, to avoid unprepared-for rupture and infection. Chromicized catgut can be employed to tie the stump in all instances; silk can be used in all except the infected cases. The sheath of the rectus abdominis should not be incised when it is practicable to avoid it, for this act may interfere with satisfactory union and repair, and affords opportunity for infiltration of unwholesome fluids along the sheath and muscular fibers; and, too, the branches of the deep epigastric artery would be exposed thereby to untimely injury. If the intestine be adherent to the abdominal wall at the seat of the abdominal incision, great prudence must be exercised to avoid a precipitate or deliberate involvement of the lumen of the gut with the knife. The pinching up of the peritonæum with the thumb and finger, as in hernial protrusions, to determine the presence of adhesions, can be practiced here with excellent result. The trunks of the nerves supplying the abdominal muscles should be carefully preserved from injury, since their division will cause paralysis and weakening of the part of the abdominal wall to which they are distributed. The placing of a drainage tube in contact with a denuded spot of the intestinal wall is liable to provoke sloughing at that point and cause fæcal fistula. The possibility of the presence of constriction of the bowel at the time of or soon after operation, by old or recent adhesions, should not be disregarded, since the symptoms of this condition may be confounded with those of the primary trouble. All bleeding points should be carefully caught and tied. The writer recalls two instances of secondary hæmorrhages following operation for extensive acute appendicitis, one very annoying, but finally controlled; the other unexpected and fatal because of infection of an extensive subperitoneal extravasation of blood.

*The After-treatment.*—After the operation the patient is wiped dry, the dressings are applied and confined in place with a broad binder so fastened below as to prevent slipping up and exposing the wound. The patient is then placed in a warm bed, provided with bottles of hot water if needed, and kept quiet. Rarely, indeed, is nourishment given during the first twelve hours, nor soon after this if gastric irritation be noted. In such cases hot water in small amounts may be sipped to quench thirst. Pain, intestinal distention, vomiting, retention of urine, etc., are treated as they arise, avoiding, when possible, the use of opium and its derivatives. The pulse, tem-

perature, and respiration should be taken before the operation and at regular intervals thereafter, so long as the patient remains in bed. Peptonized milk, koumiss, milk and Vichy, and the like, are suitable foods at the beginning; later more substantial articles can be given. In simple cases the wound is redressed in four or five days, stitches are removed, fresh dressing is applied, and the patient kept quiet in bed for ten or twelve days longer, when he is permitted to rise. If drainage has been employed it should be removed as soon as it has served its purpose. Textile fabric, especially iodoform gauze, when applied for reparative needs, should, after thorough saturation, be removed by twisting on the second or third day. Gentle irrigation or, better still, careful wiping of the cavity is practiced in the instances of the use of drainage for the elimination of inflammatory products and of their objectionable substances. In suppurating cases the patient should remain in bed for two or three weeks, or until substantial healing has taken place. The wearing of an abdominal support for some time thereafter, especially by those exposed to the influences of muscular effort, is a wise provision. It sometimes happens that the occurrence of symptoms indicative of intestinal obstruction, or of extending peritonitis, or localized suppuration, require that the wound be reopened, and perhaps that additional incisions be made, to afford the necessary relief.

**Intestinal Perforation in Typhoid Fever.**—In 1884 Leyden first proposed operative measures for the relief of this heretofore almost always fatal complication. Since that time 150 cases of operation for its relief have been reported (Keen). The great majority of the perforations occur from the second to the sixth week inclusive, the third (24.8 per cent) and the fourth (21.7 per cent) being the most prolific in this respect (Fitz).

The ileum is the seat of perforation in 81.4 per cent, the large intestine in 12.9 per cent, and the vermiform appendix in 3 per cent of the cases (Fitz). The jejunum and Meckel's diverticulum are perforated in rare instances. The transverse colon suffers least, and the descending and sigmoid flexure the most frequently of the subdivisions of the large intestine (Hawkins).

Usually but a single perforation is present, but sometimes several are found, and, besides, points of extreme thinness denoting imminent perforation are often discovered. The perforations vary in size, being in one instance so small as to often baffle detection, in another quite readily discoverable or even distinctly gaping.

*The Operation.*—The operation should be performed after subsidence of shock and as promptly as is consistent with the welfare of the patient. If the infection be general, as is usually the case, make the primary incision in the median line; if circumscribed, make it over the circumscribed area, therefore, laterally; but in either instance of sufficient size to permit of prompt and free manipulations. When apparent, extravasated contents of the intestine should be removed by careful wiping, aided by a gentle stream of hot saline solution, to avoid a needless spread of infection from handling of the intestines.

In the search for the perforation, one is guided by the knowledge of the

relative frequency of the seat of the occurrence, and by the local evidences of the inflammation, extravasation, etc. As soon as found, the borders of the opening and the continuous thinned surface are turned in without trimming, and united by the mattress suture. If the amount of the inturning be such as to cause too great closure of the bowel, then either enterectomy or enterostomy should be practiced according to the condition of the patient; usually the latter is preferable. Search for a second perforation and for weakened spots in the intestine is required when warranted by the condition of the patient; but, inasmuch as most of the perforations occur within three feet of the ileo-cæcal valve, there is but little that can be gained for the much that may be sacrificed by a larger and more extended examination.

As thorough cleansing as practicable of the peritoneal cavity and of the contents should be employed, either by a systematic wiping with sponges wrung out of a hot saline solution (Finney) or by a careful flushing with this fluid. While in some instances it may be permissible to close the abdomen without drainage, in the majority of cases drainage should be employed.

The ability to determine the presence or absence in the abdominal cavity of infective agents in advance of operation with the view of earlier action, and deciding the question of the employment of drainage, is very important, but will remain for a long time in general practical abeyance in other than hospital practice, because of the want of opportunity and the disinclination to carry it into effect in the more common paths of action.

*The Precautions.*—Careful scrutiny, aided by a suitable light, is requisite to the detection of minute or widely separated perforations, and even then, prolonged or vigorous efforts may neutralize the advantages arising from a more discreet course. The mattress suture of Halsted (page 622) is the best that can be employed because of the securer grasp on the softened structures, and of the greater rapidity of its application, especially as relates to tying, since in this variety one knot meets the purposes of two by the interrupted method. It is wise in all cases to examine the appendix, not only because of its occasional involvement in typhoid fever, but also because it alone may be at fault. The employment of local cocain anæsthesia, instead of general anæsthesia, affords the patient the better chance for recovery.

*The Results.*—The death rate without operation is fully 95 per cent. In 116 cases operated on, 22.7 per cent recovered. In operation from eighteen to twenty-five hours after the attack 31.4 per cent recovered; twelve to eighteen hours after, 29.1 per cent; eight to twelve hours after, 26.6 per cent; and during the first eight hours, 10.5 per cent recovered (Keen).

Rapidity of action in this operation influences largely the results. In but one case in which an hour or longer was taken did recovery occur.

**Peritonitis dependent on perforation** from other than typhoid ulceration is not unusual, and often is entirely unanticipated. Perforation of the intestine, dependent on various morbid processes and on the rupture of the limiting walls of infective accumulations, is often foreshadowed by symptoms peculiar to the nature and location of the causative factors. In such cases

the diagnosis of rupture is aided by a knowledge or suspicion of the existence of the contributing cause.

Generally fatal septic peritonitis is more often the result of such happenings than is the less harmful adhesive variety. The shock attendant on this class of cases differs in no practical regard from that following typhoid perforations. However, the degree of pain and the site of the primary manifestations are modified chiefly by the seat of the infection and the nature and the amount of the infecting agents.

*The operative technique* differs in no important concern in these cases from that of the typhoid until after the peritonæum is divided. The examination is then directed to that portion of the abdominal cavity toward which the characteristics of the extravasated fluid, the inflammatory phenomena, and the previous history of the case point. The removal of the infecting agents (page 612), the search for the perforation, the treatment of the distended intestines (pages 666 and 690), the cleansing and drainage of the peritonæum (page 613), are conducted as promptly and efficiently as circumstances will permit, always remembering that judicious haste is a great *desideratum* in the securing of final recovery.

*The Remarks.*—The escape of odorless gas and the presence of acid fluid along with gastric contents denote stomach involvement. If the gas be offensive, or the fluids of a purulent or fæcal character, the portion of the intestine to which they normally belong is likely to be the seat of the opening. The presence of pus, bile, urine, etc., indicate not only the probable cause of this trouble, but also the source of the fluid.

The elimination from the distended intestines of their objectionable contents by punctures or incisions of the gut is often difficult and perhaps impossible, because of intestinal paralysis and the hindrance arising from the acute flexions of the intestine dependent on a tense mesentery.

The combating of shock by local warmth, hot saline injections, and medicinal stimulation is especially indicated in these cases. The elimination of the infecting agents that may remain behind in the abdominal cavity is facilitated by the use of saline cathartics and the leaving within the cavity of a portion of the saline fluid (see page 613).

*The Results.*—The results of operation for perforations dependent on appendicitis, wounds, etc., are already treated under their proper headings. When arising primarily from unrecognized causes, the death rate varies from 15 to 30 per cent.

**Peritonitis due to tuberculosis** can be wisely treated in proper cases by abdominal section. An incision is made usually in the median line, and of sufficient length to permit of easy removal of the fluid by sponging or siphonage, the drying of the peritoneal surfaces by carefully applied sponge or gauze pressure, and coincident examination of the exposed abdominal contents. The flushing of the cavity after evacuation of the fluid by means of the saline or boric-acid solution is favorably regarded in the absence of infective agents. In simple cases the abdominal wound is closed promptly, and the patient kept quiet in bed. In those cases characterized by the presence of pus in the abdomen, or other infective influences, drainage should

be practiced from the beginning, while in simpler cases it need not be employed unless failure of cure follows the safer plan—the immediate closure of the wound.

*The Remarks.*—Abdominal section in the suppurative varieties, especially if general or in the form of multiple cysts, is very unsatisfactory. The dry and ulcerating forms of the disease offer indifferent prospects of success. If permanent drainage be established, continuous care must be exercised to prevent the subsequent occurrence of infection of the abdominal cavity.

*The Results.*—In children, in favorable cases, 60 per cent of cures are reported, with but a trivial mortality from the operation alone. In adults of the same class of cases, about 38 per cent were cured.

Operation in the dry and ulcerated forms of the disease is followed by a death rate of about 75 per cent; in the suppurative multilocular cystic kind but few recover; in the inflammatory localized suppurative form the operative outcome is quite favorable.

**Fæcal Fistula and Artificial Anus.**—The operative cure of a fæcal fistula or of an artificial anus is frequently difficult and may be impossible. The important factors of success in these cases are a sterile wound and proper union of the serous surfaces. The vigorous assaults on these desiderata of intestinal infection and the effects of previous inflammatory action often so handicap well-directed surgical efforts as to render the outcome quite problematical even in apparently simple cases. A long or devious sinus intimately connected with adjacent intestine demands the exercise of the most scrupulous care in its removal to prevent immediate or remote involvement of additional intestine dependent on direct incision, or the sloughing incident to impaired nutrition due to the injury inflicted on the intestinal coats. The removal of the communication with the bowel is a common step in the treatment of these conditions, and is supplemented by either of the following methods of intestinal repair best suited for the case: 1, Simple incision and closure of the opening by sewing; 2, elbowing; 3, enterectomy and direct union by (*a*) end-to-end sewing; (*b*) Maunsell's method; (*c*) Mur-

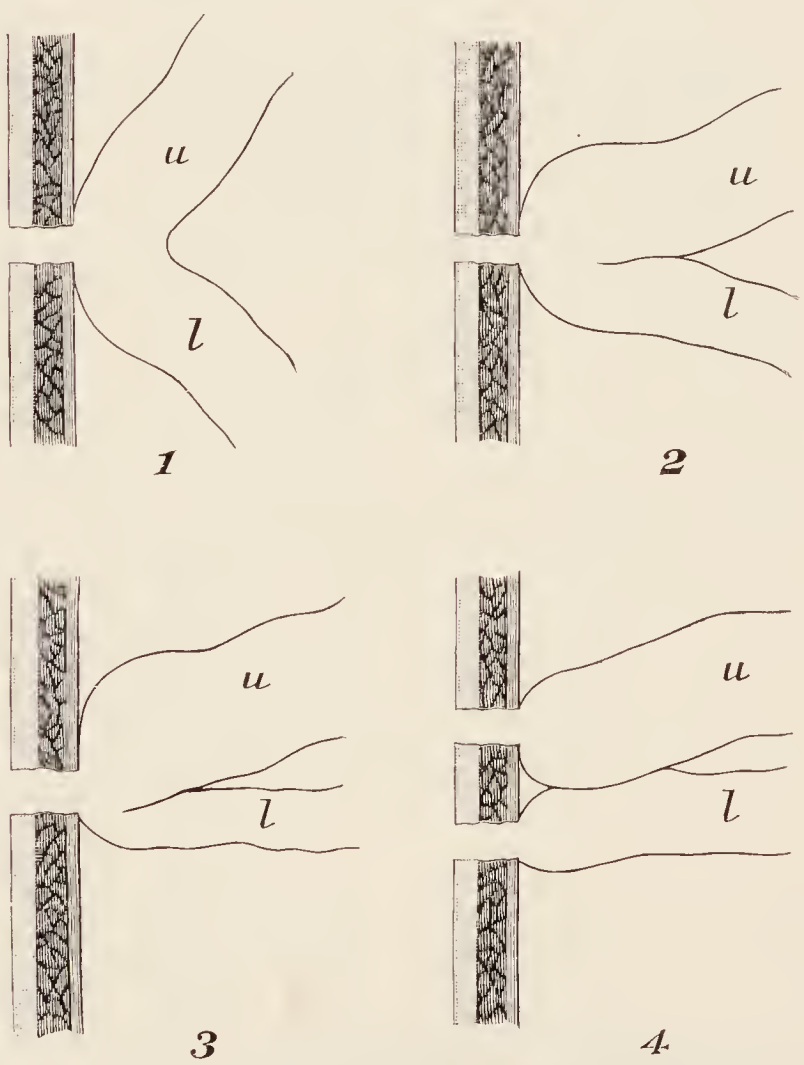



FIG. 930.—Diagrammatic illustration of fæcal fistula and artificial anus. *u*. Upper bowel. *l*. Lower bowel. 1. Fistula without a spur. 2. Fistula with an incomplete spur. 3. False anus with complete spur. 4. Double fæcal fistula.

phy's button; or indirect union by lateral anastomosis in the manner already indicated.

*The preparatory treatment* of the patient for operation contributes very much indeed to a successful outcome. The intestinal canal should be evacuated thoroughly by saline cathartics, supplemented by copious rectal injections of sterilized water if the colon be the part involved, long enough before the operation to permit of the escape of the fluids from the bowels. The tissues around the opening should be made healthy and the borders be thoroughly cleansed by washing and scrubbing, and softened, too, by emollient applications if unusually hard and rigid. Fluid food alone should be given the patient. *The first step* in the operation relates to the isolation of the sinus leading to the opening in the gut. This step must be carefully practiced to prevent infection of the wound by the agency of the lining membrane of the sinus, and also to avoid injury of intestinal folds lying contiguous to and perhaps intimately connected with it. The removal of the sinus is immediately preceded by scraping and scrubbing of its walls with antiseptic fluid, followed by the passage through it into the intestine of a small sponge retained in place by means of a string attachment, the free end of which remains without. The external opening of the sinus is then closed tightly by silk sutures passed somewhat deeply through the borders and tied, the ends remaining uncut. After thorough cleansing of the part the sutures are grasped collectively by means of forcipressure and drawn upward by the surgeon or an assistant so as to elevate the included tissue (Fig. 931), and an incision an inch or so in length, according to requirements, is made with a sharp scalpel at either side of the elevated end (*b*, *d*) in the direction of the long axis of the intestine, if the colon, or vertically if the small intestine be the one involved. The corresponding extremities of these incisions are then connected with each other by two curved ones (*a*, *a'*) carried one at either side of the opening about half an inch from the border. The dissection is continued carefully either along the outer (*a*, *a'*) of

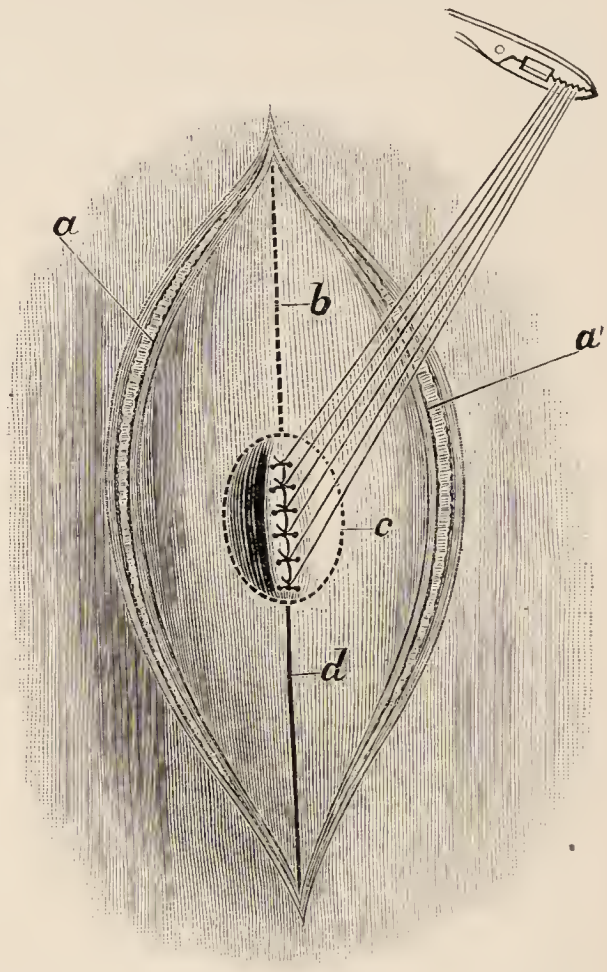



Fig. 931.—The treatment of fæcal fistula and artificial anus. *a*, *a*. Curved incisions. *b*, *d*. Vertical incisions. *c*. Border of outer wall of fistula.

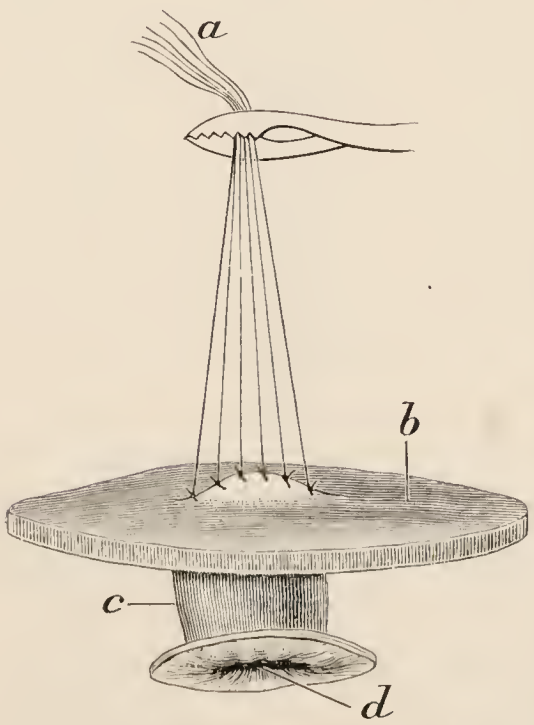



Fig. 932.—The treatment of fæcal fistula and artificial anus. *a*. Sutures. *b*. Portion removed. *c*. Wall of sinus. *d*. Lumen of sinus.

these incisions only, or combinedly with one (*b*) or both (*b*, *d*) of the straight incisions outside of the sinus down to the gut, which is then raised up well into the wound. The peritoneal cavity may or may not be involved by the dissection, depending on the extent of the adhesions, the desire to coapt the serous surfaces of the bowel in the repair, or the ignoring entirely of these

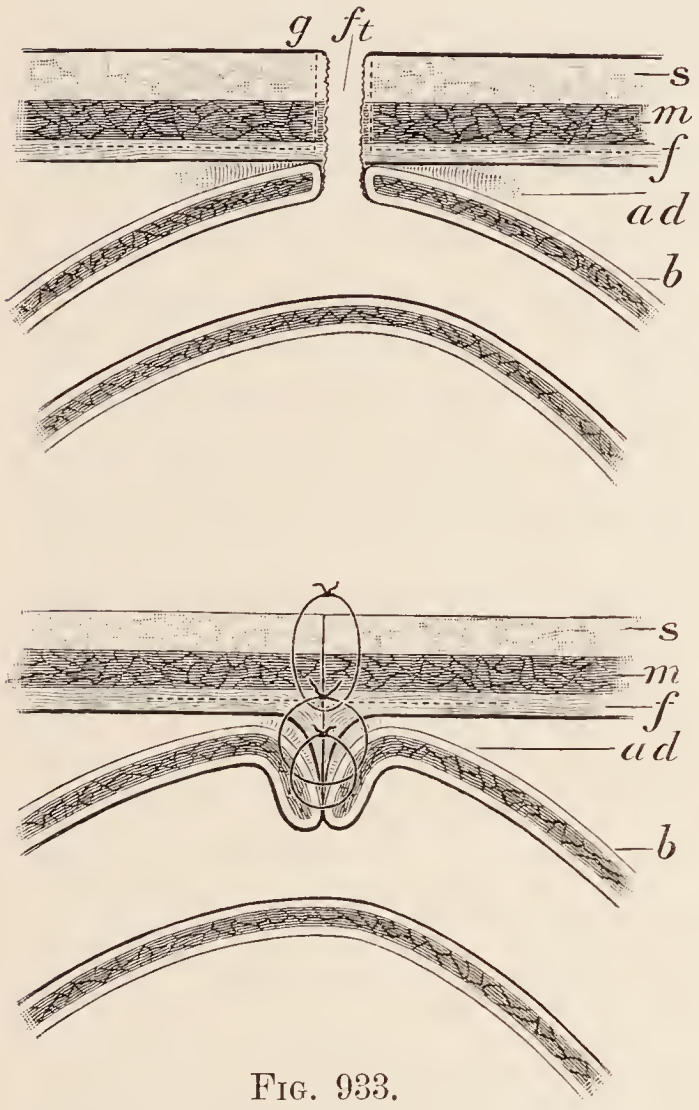



Fig. 933.

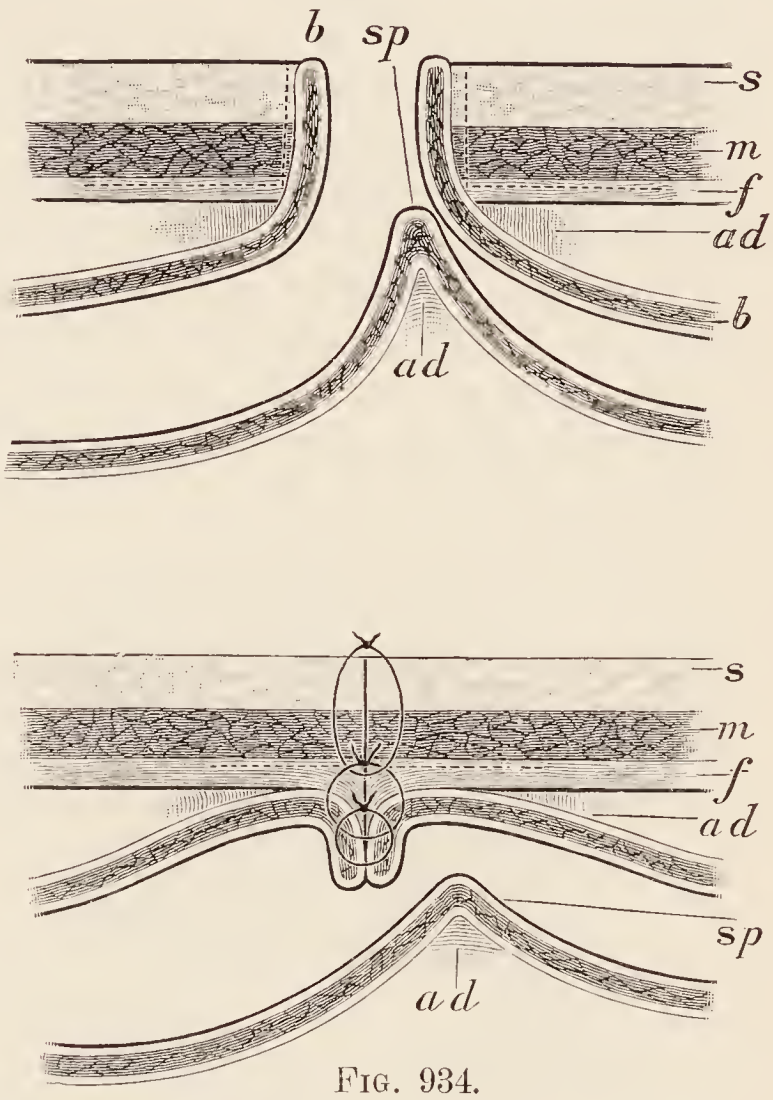



Fig. 934.

Fig. 933.—Diagrammatic illustration of closure of fistula, the dissection not involving the peritoneal cavity. *ft.* Fistula. *g.* Granulation lining. *s.* Integument and subcutaneous tissue. *m.* Muscular tissue. *f.* Peritoneal fascia and peritonæum. *ad.* Adhesion between bowel and parietal peritonæum. *b.* Bowel. Dotted line indicates course of incision for removal of sinus. Wound closed with sutures.

Fig. 934.—Diagrammatic illustration of closure of artificial anus. *ad*, *ad.* Adhesions between serous surfaces of spur, and between bowel and peritonæum. *b.* Bowel. *f.* Peritonæum and subperitoneal fascia. *m.* Muscular tissue. *s.* Integument and subcutaneous tissue. *sp.* The spur. Dotted line indicates course of incision for removal of fistula. Wound closed with sutures.

surfaces followed by the apposition of non-serous structures only in the closure of the opening. The sinus is then removed (Fig. 932), and if the opening be small the borders are inverted and closed by sewing in the manner already expressed (Figs. 792 and 862, *d*). If the peritoneal cavity be not involved, serous tissues are not utilized, and the method of union is indicated in the foregoing illustration (Fig. 934). If the area of adhesion be unusually limited in extent in this instance, the peritoneal cavity may be involved and serous surfaces are then approximated in the repair. If serous surfaces be desired for repair, the dissection must be extended beyond the limits of the area of adhesion, thus freely opening the peritoneal cavity and calling for a corresponding increase in vigilance. If the intestinal opening

be so extensive as to forbid simple closure, "elbowing" (Figs. 865 and 866, *d*) may be practiced, which calls for peritoneal-cavity involvement and serous-surface coaptation. If neither of the preceding plans be prudent, removal of the segment of gut involved in the fistula and the adjacent adhesions should be practiced (enterectomy), and the repair completed by end-to-end union (page 658 *et seq.*) by the method best intended to meet the demands of the case. *Lateral anastomosis* (page 644 *et seq.*) may be practiced after enterectomy, if necessary, and even without it in the small intestine by the Murphy button, by sewing, by plates, bone and potato bobbins, etc., thus establishing a short circuit (Fig. 829) and thereby eliminating the loop of intestine involved in the sinus from the line of fæcal flow, which sometimes results in spontaneous cure.

**Greig Smith's Method of Treatment.**—*Greig Smith* aimed to cure the fistula without peritoneal-cavity involvement. After proper cleansing of the opening and plugging to prevent infection, an incision is made in the direction of the underlying muscular fibers, outward for an inch or two from near the margin of, but not involving, the fistula (Fig. 931, *b*, *d*). The inner end of the incision is carried around the fistula outside the cicatricial border (*c*), and the dissection is continued carefully downward to the subserous tissue along the entire line of the primary incision (Fig. 933). The subserous and peritoneal tissues are separated from the superimposed structures carefully with the finger for two or three inches around the sinus, sufficiently at least to permit the sinus opening, the contiguous intestine, and the parietal peritonæum to be raised well up into the wound. The fistulous tract is removed and the opening closed by the infolding of the freshened surfaces and their union with each other by a primary row of interrupted, and a secondary row of continuous sutures, as in other instances of intestinal sewing. The abdominal wound is then closed in the usual manner. By this method the peritoneal cavity is not involved, the minimum of danger is incurred, and entire dependence is placed on the union of non-serous surfaces. *Smith* gives notable instances of complete success by this plan, and regards the apposition of serous surfaces as not essential to cure. It is apparent at once that the incision can be extended through the peritonæum, so as to utilize the serous surfaces for repair when desired. *Senn* advises that the fistulous opening be closed tightly by closely applied sutures, instead of by plugging it with cotton or gauze, not only because the former

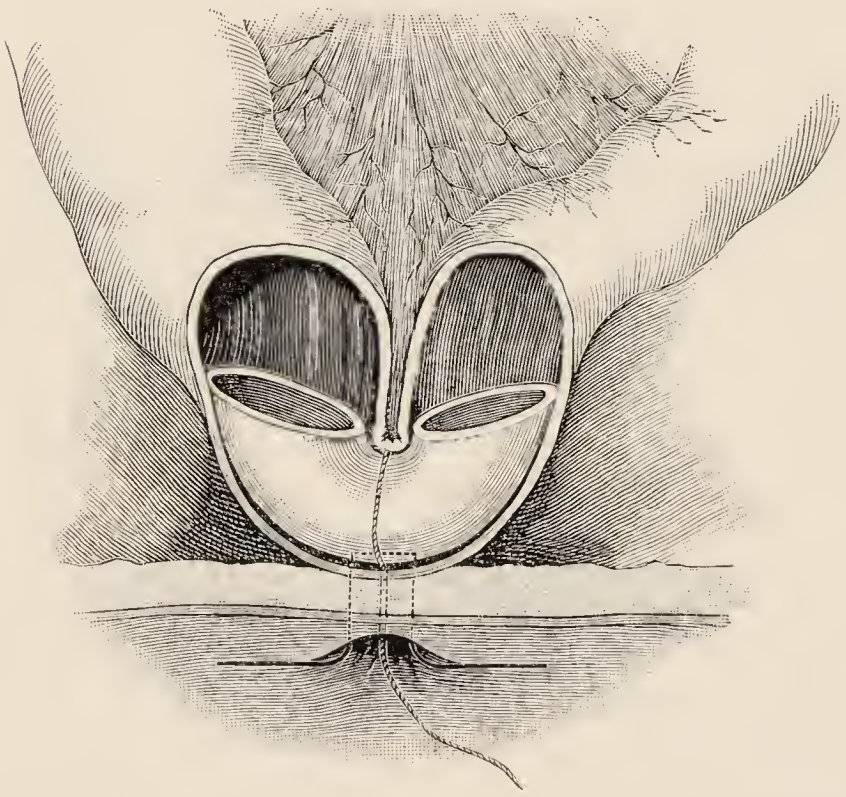
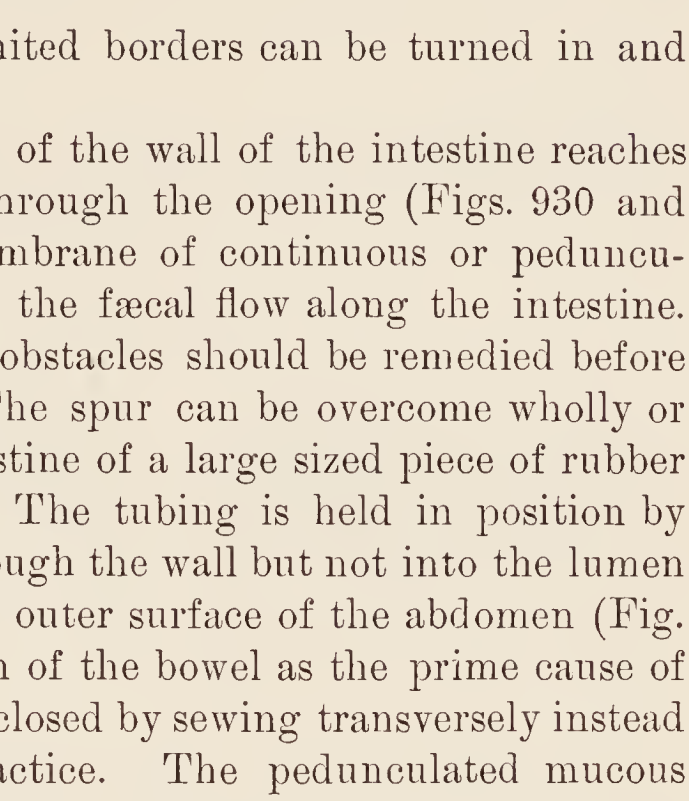


FIG. 935.—Overcoming spur by rubber tube. Tube held in place by string or by wire.

is the more secure, but thereafter the united borders can be turned in and buried by Lembert sutures.

Not infrequently a projection or spur of the wall of the intestine reaches upward, so as to direct the fæcal flow through the opening (Figs. 930 and 938). Sometimes prolapsed mucous membrane of continuous or pedunculated arrangement offers an obstacle to the fæcal flow along the intestine. The ill effects of the spur and the other obstacles should be remedied before the attempt of final closure is made. The spur can be overcome wholly or in part by the introduction into the intestine of a large sized piece of rubber tubing so placed as to depress the spur. The tubing is held in position by fine silver wire, or by a string passed through the wall but not into the lumen of the tube, and fastened securely on the outer surface of the abdomen (Fig. 935). Inasmuch as *Senn* regards flexion of the bowel as the prime cause of the spur, he advises that the opening be closed by sewing transversely instead of longitudinally as is the common practice. The pedunculated mucous structures can be drawn up and tied off with fine silk if their attachments be small. The author in one instance removed a spur in ten days without trouble by the application to it through the opening in the bowel of a small-sized Murphy button. *Robson* cured a fæcal fistula complicated with stricture of the intestine by exposing and dividing the stricture in the long axis of the intestine, followed by the introduction of a decalcified bone bobbin into the lumen and its confinement in place by closure over it of the denuded tissue by transverse suturing. The mucous margins were united by a continuous catgut, and the serous by a silk, suture. The patient made a prompt and uneventful recovery, and has remained well since that time.

*Instrumental methods of removal of the spur*, with a view of curing a fistulous opening, are among the oldest of practice. At the present time much less notice is given them than formerly. The enterotomes of Dupuytren, Collin, etc. (Fig. 936), are well-known instruments. The enterotome devised by Gross is better than either of the preceding, because it not only divides but removes the spur (Fig. 939). The method of Bodine (page 679), directed both to the formation and removal of the spur, is the latest and best of the series.



*a* *b*

Fig. 936.—The enterotomes. *a*. Dupuytren's enterotome. *b*. Collin's enterotome.

*The Remarks.* — The enterotome should be so applied as not to open into the peritoneal cavity, and should remain from one to two weeks, or until liberated by necrosis of the included tissues. Only sufficient of the spur should be grasped to effect the removal of the requisite amount, thereby limiting the danger of perforation and

the possibility of including in the grasp of the instrument a nearby intestinal loop.

*The Results.*—The tendency to abandonment of this somewhat crude method of practice is not yet justifiable, especially since it is evident that the

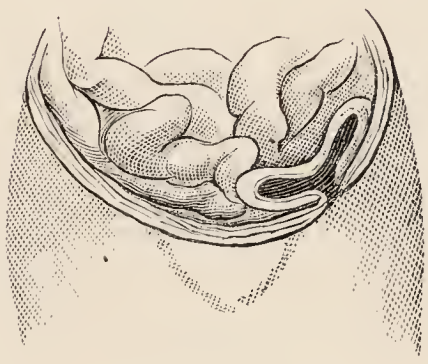


FIG. 937.

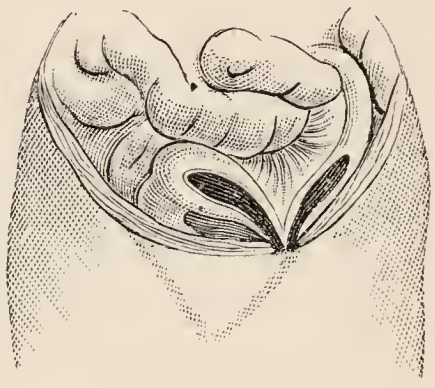


FIG. 938.

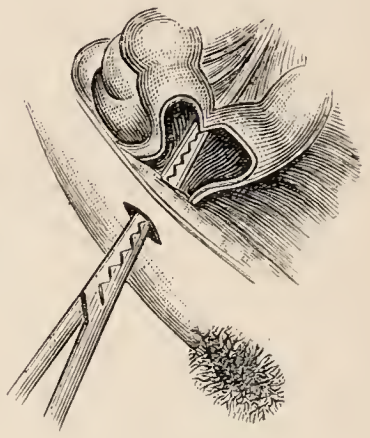


FIG. 939.

FIG. 937.—Artificial anus without a spur. The intestine is partially opened in the vicinity of the artificial anus.

FIG. 938.—Artificial anus with spur. The afferent and efferent portions of the bowel are partially opened.

FIG. 939.—The destruction of spur by enterotome. Anterior wall of the intestine cut away to show better the position of enterotome.

death rate attending it (8 to 9 per cent) is nearly 16 per cent less than that of resection of the bowel for cure. Sixty per cent are cured by the method, and quite 30 per cent much relieved.

*The General Remarks.*—If the peritoneal cavity be involved in the operation, failure of union of the intestinal opening is exceedingly dangerous, especially if the abdominal wound has been closed. Therefore, if there be reason to regard union as at all problematical, the abdominal wound ought not to be closed entirely, and the field of repair should be carefully isolated from the peritoneal cavity by strips of iodoform gauze. If the colon be the intestine involved, lateral approximation (if practicable) is the best method, for then serous surfaces only will be in juxtaposition. End-to-end union with the large Murphy button or by Maunsell's method comes next in order of efficiency in the majority of instances. Direct enterorrhaphy is less promptly done, because the exercise of vigilant care is required for a safe union of the borders of gut not covered with serous membrane, and defective repair will invite prompt and fatal disaster. In case of closure of intestinal openings with uncertain outcome, it is wiser to invert the edges without trimming, since in the case of failure the opening would not be increased in size. The introduction into the fistulous tract of a catheter, large probe, gauze packing, etc., to better define the outline during the removal, is a commendable procedure. *R. Morris* advises the employment of plaster of Paris for the purpose, since, when introduced in a plastic condition, it fills the inequalities of the tract, and when hardened enables the surgeon to estimate its limits better than by any other means. Transverse sewing of the opening should be employed if possible, in lieu of the longitudinal variety, when the latter reduces unduly the lumen of the gut. The detachment of the parietal peritonæum in this operation should commence at the distal ends of the

incision instead of close to the border of the fistula, thus reducing the liability of opening the peritoneal cavity to a minimum. The divided tissues of the abdominal wall should be closely apposed by sutures to eliminate the occurrence of dead spaces. The presence in the bowel of the rubber tube—for the purpose of lessening the spur (Fig. 935), and perhaps sufficiently diminishing its obstructive influence to effect a cure—is attended not infrequently by a marked irritation which, on removal of the agent for two or three days, quickly subsides.

*The After-treatment.*—As fluid food only is given for two or three days before operation, the continuance of the same thereafter for a brief period is a valuable element of treatment. The patient is kept quiet and the wound carefully observed after the third day for the presence of manifestations of failure of repair in order to anticipate the possibility of the occurrence of fæcal extravasation.

*The Results.*—Failure of the attempt at closure of fistulæ is not infrequent, consequently an indulgence in glowing prognosis should be avoided. The death rate in simple cases should be insignificant if the aseptic and other technique be supplemented with proper post-operative vigilance. *Makins* reports a death rate of 38.4 per cent from thirty-nine cases of resection for the cure of fæcal fistula. About 10 per cent less than the above now conforms more nearly to the operative results.

*The operations* connecting the intestine with the stomach (*gastro-enterostomy*), with the gall bladder (*cholecystenterostomy*), with the ureter (*uretero-enterostomy*), etc., are noted elsewhere under more significant headings.

## THE OPERATIONS ON THE STOMACH.

It is necessary sometimes to open the stomach to remove foreign bodies, to supply nutrition, to overcome œsophageal obstruction, or to remedy the various other conditions of a surgical nature that are amenable to interference through direct incision of the stomach. In each instance the opening in the abdomen and the viscus is made as small as may be consistent with the proper operative technique. It follows, therefore, that the digital sense is of great practical utility in the determinative and diagnostic elements of the procedure. The finger should be educated, by repeated lessons on the dead subject, to recognize the individual characteristics of the respective tissues involved in the operation, their relations with each other, and the presence of tangible evidences of disease complications, without unnecessary delay or harmful manipulation.

*The Anatomical Points.*—Whether or not the stomach be collapsed or distended, or be influenced by the respiratory acts or the effects of disease, determines very largely, indeed, its relations with the associated organs and tissues. When empty it lies posteriorly and beneath the liver and at a considerable distance from the abdominal wall in front, and upon the transverse mesocolon, which separates it from the pancreas, the large abdominal vessels, and the solar plexus (Fig. 940). With increasing distention the anterior wall looks upward, the posterior downward, and finally the former rests

against the abdominal wall in front. In the normal state the cardiac orifice is close to the chondro-sternal junction of the left seventh rib. An empty pylorus lies about three inches below this articulation and at the right of the linea alba; when distended it is two or three inches farther to the right. A triangle formed at the right by the edge of the normal liver, at the left by the free borders of the eighth and ninth costal cartilages, with its base at a line extending between the tips of the tenth costal cartilages, corresponds to the surface of a moderately distended stomach lying immediately beneath the abdominal wall, at which time the greater curvature lies quite near to the transverse colon, and each has been mistaken for the other in operative practice (Fig. 942). The position of the stomach is changed by respiration, descending with the inspiratory, and ascending with the expiratory, act.

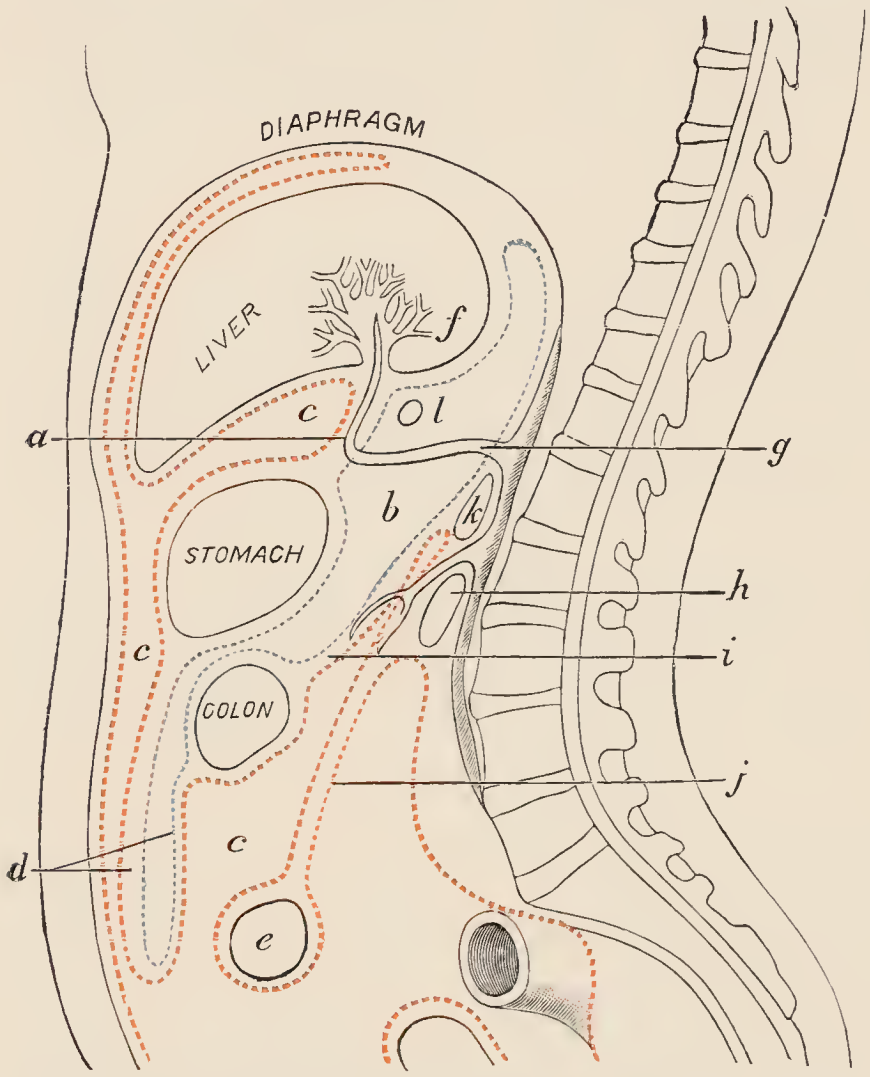



FIG. 940.—The relations of the stomach, etc., to the peritonæum and contiguous organs. *a*. Gastro-hepatic or lesser omentum. *b*. Lesser peritoneal cavity. *c*. Greater peritoneal cavity. *d*. Folds of great omentum. *e*. Small intestines. *f*. Liver. *g*. Cœliac axis. *h*. Duodenum. *i*. Transverse mesocolon. *j*. Mesentery. *k*. Pancreas. *l*. Foramen of Winslow.

*The identity of the stomach* is established by its immediate relation with the under surface of the liver and the continuity with the anterior layer of the gastro-hepatic omentum; by its broad, smooth surface, pale color, dense structure, and the characteristic arrangement of the vascular supply. It is placed obliquely, running downward from left to right in the adult, and almost vertically in early life.

**Gastrotomy.** — The operation of gastrotomy contemplates the temporary opening of the stomach for the removal of foreign bodies, for pyloric and œsophageal exploration, and for other measures intended to determine the presence of pathological states that may be amenable to prompt surgical remedy.

*The Preparatory Treatment.*—The general condition of the patient should first be fitted for the operation by the employment of remedies, when the benefit to be gained thereby is regarded an adequate recompense for the delay in operative procedure. Usually, however, the effects of procrastination are so well marked already when the patient comes under the observation of the surgeon, as to demand prompt action if a favorable outcome is to be expected. If there be no obstacle to the measure, the stomach should be thoroughly washed out with a solution of bicarbonate of soda

before the operation. If the organ be small, it may be deemed advisable to allow five or six ounces of the fluid to remain, that the location of the stomach may be the more readily determined. However, the employment of distending measures of any kind are not now regarded as essential or even wise, except in special cases, as they may prove obstructive and even disastrous if the peritoneal cavity be infected by their incontinent escape. The intestinal tract should be thoroughly cleansed, especially the large intestine, to fit it the better to retain nutritive enemata. Strict asepsis should be exercised in connection with every detail of the operation.

Chloroform anæsthesia, because it is followed by nausea and vomiting less frequently than ether, is preferable in operative surgery of the stomach, unless special objection to its use be present. After proper anæsthesia, the patient is placed on the back with the legs extended. The operation field is prepared after the manner before stated (page 608 *et seq.*). Local anæsthesia from cocain should be used instead of general anæsthesia when haste or great prostration forbid the employment of the latter.

*The Operation of Gastrotomy.*—Make an incision two or three inches in length in the median line over the stomach down to the peritonæum (Fig. 963); arrest hæmorrhage, then divide the peritonæum to nearly the extent of the primary incision; grasp the borders of this membrane, draw them slightly upward and transfix each border of the wound through the entire thickness with a curved needle armed with a long traction suture; tie a single fold in each suture, thus drawing the respective tissues of each border of the wound in contact with each other; seize the ends of each suture independently with a forcipressure, or form a loop of each by tying the extremities together; pull apart the borders of the wound by means of the traction sutures; introduce the index finger and thumb of the right hand into the wound and pass them backward along the under surface of the liver to the gastro-hepatic omentum (Fig. 940); depress the hand, thus bringing the thumb and finger in contact with the upper surface of the stomach, which is recognized by the broad, smooth surface and its contiguity to the liver (Fig. 942); seize the viscus near the lower border with the thumb and fingers and draw the anterior wall well up into the wound; make sure that the stomach has been seized by ocular examination. Cause the assistant to seize the stomach at either side of the abdominal wound with the thumb and fingers; carefully introduce between the protrusion and the borders of the abdominal wound fine sponges to which long strings are tied for identification; supplement the sponges with aseptic gauze, wet with saline solution if advisable; pass a traction suture of silkworm gut deeply into the wall of the stomach at either side of the line of proposed incision; make an opening two inches in length into the stomach in the vertical axis parallel with the vessels (Fig. 942); raise the opening still farther upward by means of the traction sutures, aided by small retractors if necessary, and arrest hæmorrhage. If the stomach have not been washed out and the need for it be present, turn the patient carefully to the right side so as to allow the contents to escape, directing them away from the patient by oiled silk or abundant gauze. Finally, flush the stomach with hot sterilized water or a bicarbonate-of-soda solution, if

requisite for further cleanliness or better technique. Carefully cleanse the parts and draw the lips of the incision in the stomach together by crossing




FIG. 941.—Instruments employed in gastrotomy and gastrostomy.

*a*. Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Curved and straight scissors. *e*. Thumb forceps. *f*. Needle-holder. *h*. Retractor. *i*. Sponge-holder. *j*. Tenaculum. *k*. Round straight needles armed with black silk, also curved needles. *l*. Traction loops. *m*. Silk and catgut sutures. *n*. Sponge with string attachment. *o*. Large and small gauze pads with tape attachments and forcipressure anchor of pad. Perforated rubber dam for isolation is employed (Turck).

the traction sutures; renew the sponge and gauze packing if need be, and return the patient to the dorsal position. Introduce the index finger care-

fully into the stomach and search for and locate the cause demanding the operation, enlarging the gastric wound sufficiently to admit the thumb and even the entire hand if needful for complete examination.

*The Remarks.*—If the exploration be for the purpose of overcoming obstruction at the pyloric or the cardiac orifice, or for the removal of a foreign body by way of either of these openings, or from the stomach itself, the steps necessary for the attainment of the object are carried into effect with caution, to avoid needless injury of the viscus and of the borders of the wound. Therefore, the location of the abdominal incision should be varied to conform with the requirements of the case. As, if examination of the cardiac opening of the œsophagus (page 593 *et seq.*) or the cardiac end of the stomach be intended, the primary incision should be made in the same direction but somewhat farther from the ribs than for gastrostomy. The pyloric opening and other portions than the cardiac can be properly approached through the median incision already described. Large, fixed, and rigid foreign bodies discernible by external manipulation, or by the X rays, are often better removed through an external incision made directly upon them than through either of those just described. If a foreign body be present, it should be sought for first at the pyloric end of the organ, owing to its dependent position, and, when located, seized with forceps and removed cautiously with due respect for the injury it may inflict on withdrawal. It is better practice to increase the size of the stomach incision so as to allow easy removal than to bruise the tissues by forced action. If the examination is for disease of the stomach, the borders of the wound should be opened widely by the traction sutures and retractors, after which the walls of the cavity of the viscus can be readily inspected in detail when separated by small sponges on holders, aided by a strong concentrated light (Fig. 681, *o*). The wound in the stomach is closed by sewing together the mucous borders with a continuous fine silk suture, followed by union of the remaining coats with interrupted or continuous sutures of similar material. Even a third row of silk sutures should be added if any doubt of security be present. After thorough cleansing with the saline solution, the traction sutures are removed and the stomach is allowed to fall back into place. The abdominal wound is then closed by means of tier suturing (Fig. 779) or otherwise. Incisions for exposing the stomach should not be vertical, except when made in the median line, for when vertical incisions are located elsewhere the filaments of the abdominal nerves are divided, and this is followed by loss of power of the muscular structures to which they are distributed.

*The After-treatment.*—The patient should be kept quiet and sustained by nutrient enemata for the first few hours. Light fluid food is then given in small amounts at frequent intervals for two or three days, followed soon by simple though easily digestible food of a more substantial nature.

*The Results.*—About 20 per cent die from the operation of gastrotomy. The conditions demanding the operation contribute much more to the fatal results than does the operation itself.

**Gastrostomy.**—The operation of gastrostomy signifies the establishment of a fistula leading from the stomach to the external world for the purpose

of preventing starvation. Gastrostomy is practiced with strict aseptic precautions. The employment of nutritive, stimulating enemata should precede for a longer or shorter time the performance of the operation. Too often the favorable opportunities afforded by surgical intervention in these cases have been greatly impaired or apparently already sacrificed by irrational delay before the surgeon is consulted. In such cases as these complicated surgical effort under general anæsthesia is quite surely fatal. Therefore, local anæsthesia, attended by simple operative practice, should be employed, or tubage (page 605) utilized instead, as may seem wisest at the time. In any event, local warmth should be provided and general stimulation practiced before the operation is commenced. The instruments required differ in no special regard from those for gastrotomy (Fig. 941).

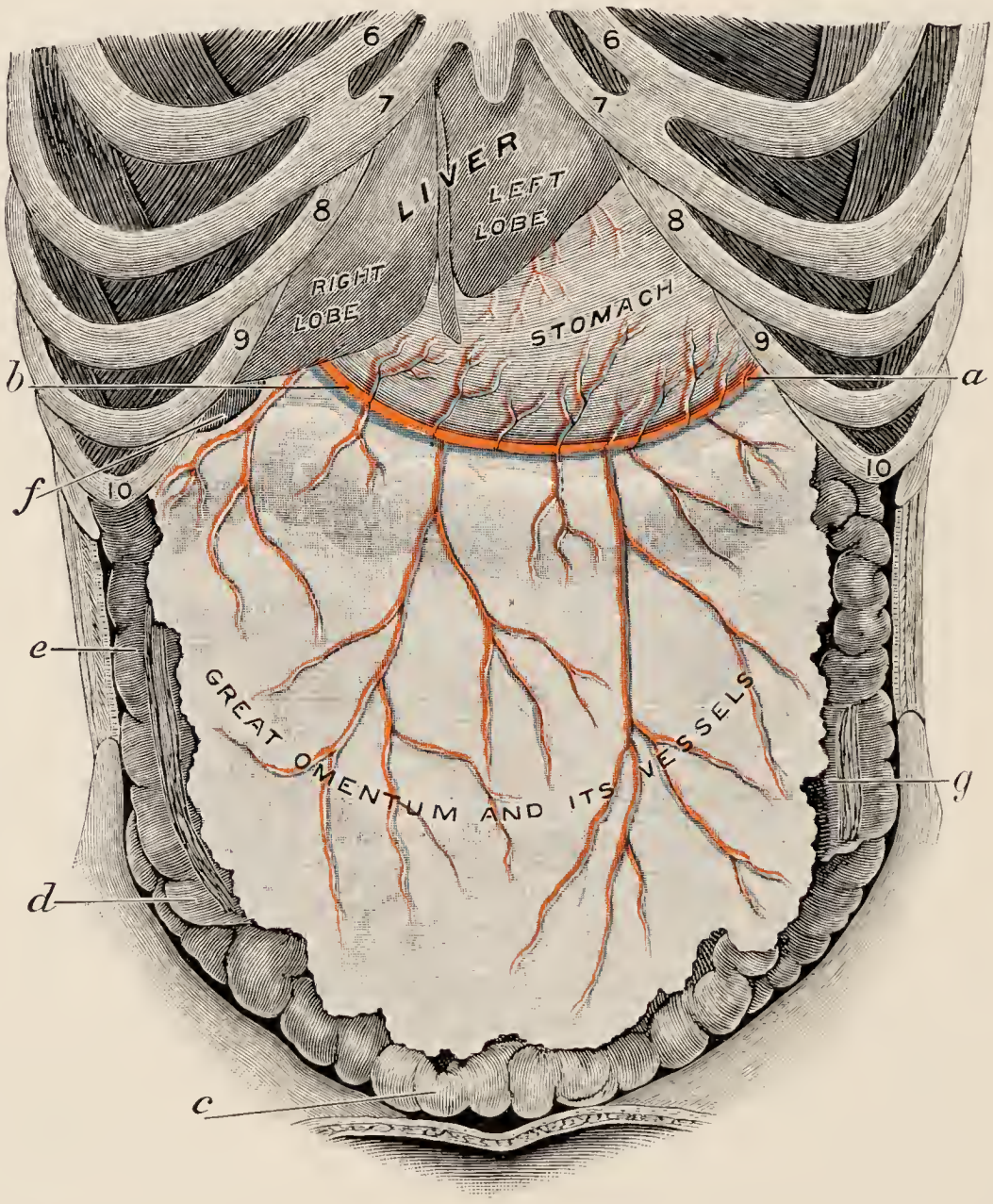



FIG. 942.—The anterior surface of the stomach, showing its relation to the liver, the transverse colon, the great omentum, and the cartilages of the ribs. *a*. Gastro-epiploica sinestra artery. *b*. Gastro-epiploica dextra artery. *c*. Small intestines. *d*. Cæcum. *e*. Ascending colon. *f*. Gall bladder. *g*. Sigmoid flexure.

*Stages of the Operation.*—The operation may be completed at one sitting or divided into two stages (Howse), according to the nutritive demands of the case or the special method of procedure adopted. In either instance it can be divided into the following steps: 1, The locating and making of the abdominal incision; 2, the exposing and drawing into the abdominal wound

of the requisite portion of the stomach ; 3, the fixation and opening of the stomach.

*The First Step* (*Locating and Making Abdominal Incision*).—Locate the free margin of the liver and the costal cartilages of the eighth and ninth ribs on the left side; make an oblique incision two inches and a half in length with the center an inch below the free margin of the liver (Fig. 963) parallel with and an inch and a half inside the borders of the costal cartilages of the eighth and ninth ribs down to the external oblique muscle (Fig. 942) ; divide the fibers of the external oblique, separate those of the internal and hold them apart with blunt retractors ; divide the fibers of the transversalis muscle, thus reaching the transversalis and subserous fasciæ, which are then likewise cut. Arrest hæmorrhage, pick up the peritonæum with forceps, and carefully divide it to an extent similar to that of the other tissues. Introduce traction sutures entirely through each border of the wound, and tie and loop as before described (page 739).

*The Remarks.*—Since this class of patients is usually very much emaciated, the tissues to be divided are naturally inclined inward and downward from the free borders of the cartilages of the ribs, therefore the edge of the knife should be turned backward and a little outward to secure a proper division of the respective structures. This incision sometimes involves the sheath of the rectus muscle and perhaps the muscle itself. In the latter instance the fibers can be cut or pulled aside as seems best at the time. *Jacobson* prefers a vertical incision made from a point opposite the inner end of the eighth intercostal space (Fig. 963) downward for three inches parallel with and about two inches to the outer side of the linea alba. The fibers of the rectus abdominis are exposed and separated without division, the posterior layer of the sheath is divided vertically, the borders of the wound are separated and the fasciæ and peritonæum divided as before.

*The Second Step* (*Exposing and Drawing Part of Stomach into Wound*). —Draw apart the borders of the wound with the traction sutures, aided by blunt retractors if necessary, bringing the lower border of the liver, and perhaps the stomach, into view ; pass the index finger backward along the under surface of the liver to define the stomach, if not already apparent ; seize and draw the stomach forward and locate the best point for the opening. In determining this fact, remember that the opening should be located as near to the greater curvature and the cardiac end as is possible consistent with the integrity of the vascular supply (Fig. 987). Entire freedom from needless traction on the organ after its union with the abdominal wall should also be secured. Having fixed on the point of opening, seize the wall at that point with forceps, and draw into the wound the necessary amount of the viscus to conform to the requirements of the method of operation adopted.

*The Remarks.*—The stomach may be mistaken for the transverse colon (Fig. 942), especially when the former is much contracted, or when the latter promptly presents at the wound. However, the differences in the color, density, smoothness, omental connections and relation with the liver, should promptly prevent the possibility of error in this respect. Often the great

omentum will appear at the wound, and especially if the colon be drawn upward by retraction of the stomach or the manipulations of the operator. If the stomach be unusually small, or have become contracted from the effects of disease, or be adherent posteriorly, much difficulty may be experienced in properly connecting it with the external opening. As soon as the abdomen is opened, the entrance of air often causes abdominal distention and also the retreat of the stomach backward beneath the liver, thus adding an impediment to the bringing forward of the viscus.

*The Third Step* (*Fixation and Opening of the Stomach*).—Draw the stomach forward into the wound sufficiently to form a neck at that situation of about three fourths of an inch in diameter; transfix the extremities of the abdominal wound with silkworm-gut sutures carried through the whole thickness of the abdominal wall; unite the neck of the protrusion with the borders of the abdominal wound by means of several silkworm-gut sutures carried through the serous and muscular coats of the former, thence outward through the entire thickness of the abdominal wound, by a curved needle; pass a guiding suture through the apex of the protrusion, tie the sutures at either end of the wound, thus fixing the protrusion in a secure position; dust the wound and the protrusion with iodoform, apply protective dressings, put the patient in bed, providing for comfort and proper nutrition, thus ending the technique of *the first stage* if the operation is to be thus divided. If not, an opening is made into the stomach at once instead of after two or three days' delay, remembering that if the opening be made too near the pyloric end of the stomach, regurgitation of food may result.

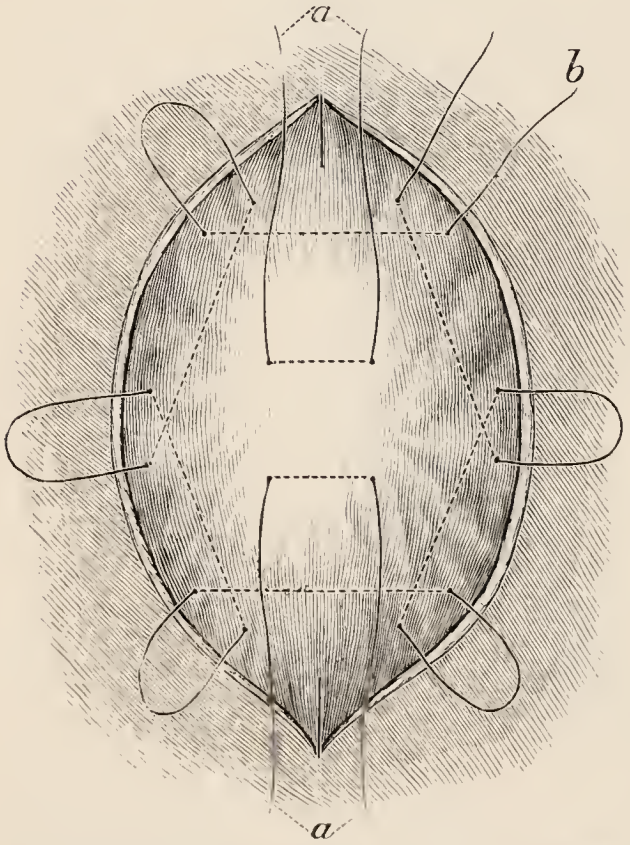



FIG. 943.—The fixation of the stomach in gastrostomy, Howse's method, first step.

*The Remarks.*—Additional security is gained by the use of fine sutures between the preceding ones, uniting the wall of the protrusion and the border of the wound with each other somewhat superficially. If time will permit, the outer coat of the protrusion can be united by means of a primary row of continuous or interrupted silk or catgut sutures with the borders of the divided peritonæum. However, here as elsewhere, about the abdominal cavity, the parts when thus arranged in the opening are less securely fixed than when joined directly with the borders of the wound. The modified suture of *Howse* is regarded by Greig Smith as being the most secure for the purpose (Fig. 943). It is applied as follows: Introduce two silver-wire loops near the site of the proposed opening (*a*, *a*) in the stomach, to afford ease in manipulation of it during sewing; convey a needle armed with a soft silk ligature (*b*) about a foot in length around the base of the protrusion beneath its serous and muscular coats, inserting it and causing it to emerge succes-

sively so as to form loops about an inch and a half in length, situated at about half-inch intervals, until six or eight loops are made, taking care to cause a crossing of the suture at the base of each loop, as indicated in the illustration. Then transfix the border of the wound at sites opposite to the loops with hooked needles, by means of which the loops are drawn through the skin and are then fastened in place by rubber tubing slipped beneath them. Fix the loops firmly to the tubing by drawing upon and tying the loose ends of the suture; bend the ends of the silver wire around the tubing, thus holding the stomach upward into the wound (Fig. 944). Harelip pins, long needles, and temporary sutures of silkworm gut can also be used for the purpose.

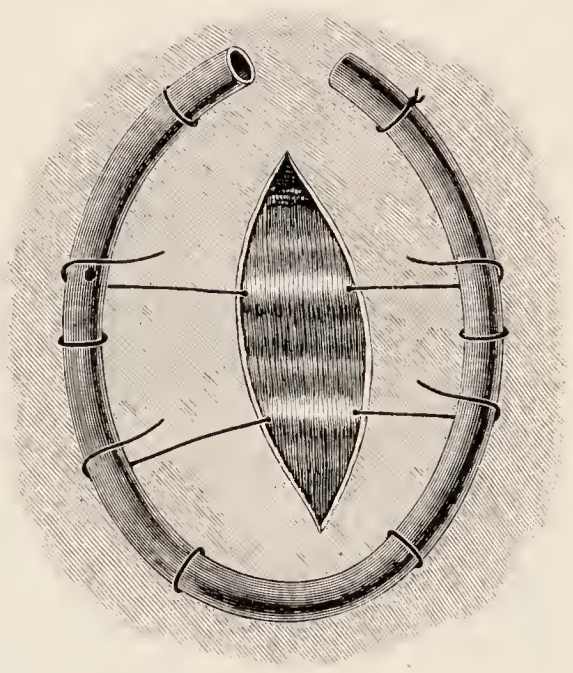


Fig. 944.—The fixation of the stomach in gastrostomy, Howse's method, fixation completed.

The latter part of the third step—opening the stomach—can be practiced at once, or deferred (*second stage*), according to the demands of the case. In either instance the point for opening is raised up by means of the guiding sutures or the forceps, and an incision large enough to admit snugly a rubber tube of the size of a No. 8 or No. 10 Eng. catheter is made into the stomach with the end of a sharp-pointed bistoury. The tube should be freely flexible, about eighteen inches in length, and provided with a small funnel for feeding the patient. The cautery is sometimes employed in opening the stomach, but has nothing to commend it except the prevention of hæmorrhage, which, with proper care, is so insignificant and so readily arrested as not to be of serious import.

*The Remarks.*—If the making of the opening be deferred for four or five days, firm adhesions will have taken place between the stomach and borders of the wound, and leakage into the peritoneal cavity need not be regarded as possible. A troublesome cough is a contraindication to the operation.

*The After-treatment.*—The character, amount, and plan of administration of nutrition by the rubber tube differs in no essential regard, after a little time, from that by means of the normal œsophageal tube, except that the quantities introduced are smaller, more finely divided, and more frequently given for obvious physiological reasons. Koumiss, peptonized milk, with eggs, brandy, etc., can be given at first frequently and in small amounts (half an ounce or so), and gradually increased as the case progresses. The mastication of food by the patient before its discharge through the tube into the stomach adds to the act the pleasure of gustation and to the food the digestive influence of the saliva (Fig. 945).

*The Precautions.*—The food should be strained to prevent blocking the tube, and be given at the temperature of the body. If regurgitation happen the patient should lie on the back during the administration of food.

In the interim of feeding, the tube is fastened against the abdomen in the form of a coil, with the open end surrounded with absorbent gauze to permit the ready escape of the fluids and gases through the tube, when necessary, rather than through the opening by the side of the tube. The tube should be kept clean and changed often enough to preserve its sanitary condition and structural integrity. The free use of vaseline after washing the surface of the abdomen with limewater and aseptic solutions will reduce the annoyance from contact with gastric fluids to a minimum. The opening of an established fistula is closed with a pad of non-absorptive material after removal of the tube in feeding.

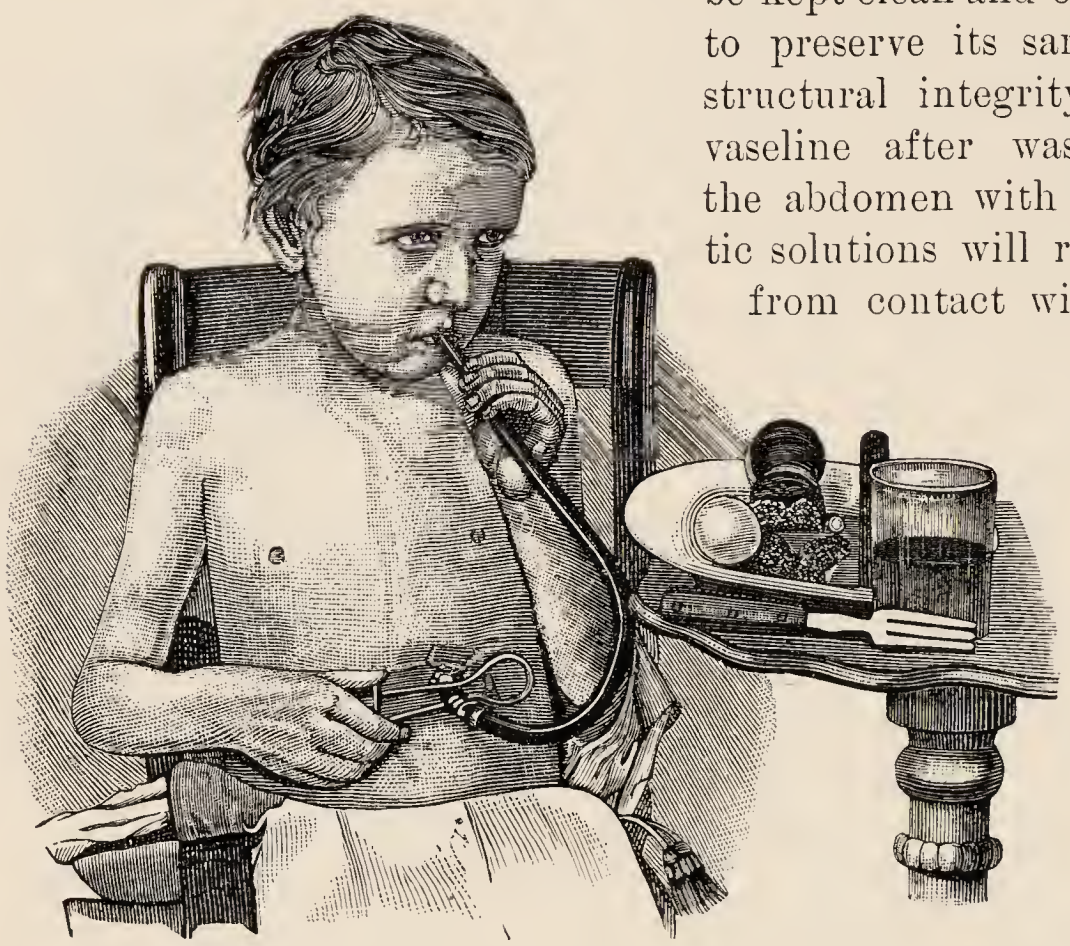


Fig. 945.—Patient feeding himself through a gastric fistula.

*The Results.*—According to Gross, the rate of mortality as based on 207 cases is 29.47 per cent. In 162 cases Zesos estimated it at 60 per cent in cicatricial and 84 per cent in malignant stenosis. When it is considered that the latter observer dealt with cases treated under antiseptic technique, it is apparent that a fallacy in reasoning exists in one or the other conclusions of these surgeons. Later estimates place the rate of mortality at about 28 per cent in malignant cases, and at about 19 per cent in non-malignant.

**Witzel's Method.**—Witzel's method is one especially directed to the establishment of a canal or pseudo-œsophagus along the wall of the stomach, which is much better suited to prevent the escape of the contents of the stomach through the abdominal opening than is the preceding method.

*The abdominal incision* is made at the left side and at the place best suited to the practice of the surgeon or the demands of the case. Usually it is made about three inches in length, beginning near the median line and passing obliquely downward and outward across the rectus abdominis parallel with and an inch to an inch and half below the borders of the costal cartilages (Fig. 963). The muscular fibers of the rectus abdominis are differently treated in the course of the incision. They can be divided obliquely, separated vertically (Von Hacker), or folds of muscle can be caused to cross each other from either side of the line of separation between which the wall of the stomach is drawn up (Girard). In the last two examples the formation of a sphincter to control the opening is aimed at, and in the majority of instances with beneficial results. The stomach is drawn into the wound

sufficiently to permit full scope for the necessary manipulations, and the borders of the wound are packed with gauze. A small opening is then made into the stomach, directed toward the cardiac end, of sufficient size to admit somewhat snugly the end of a rubber tube (size 25 French), of which about an inch is introduced and the external portion is pressed upward against the stomach parallel with the borders of the abdominal incision, and

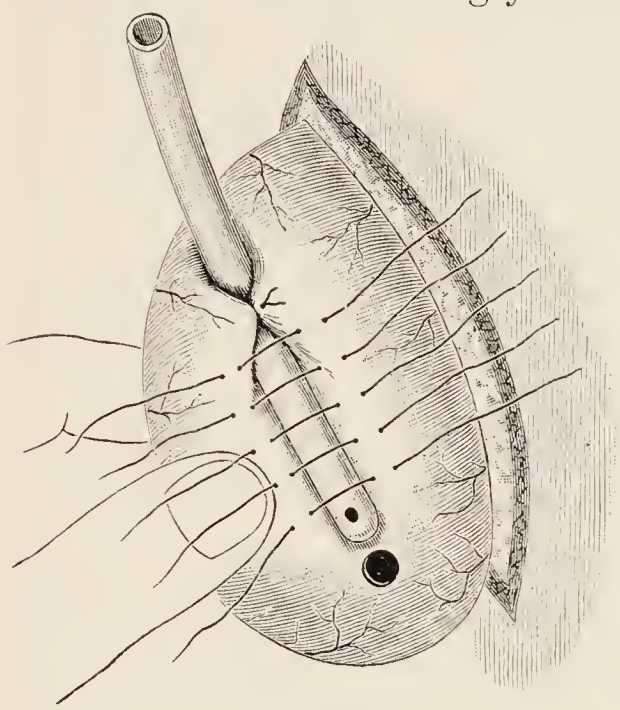


FIG. 946.

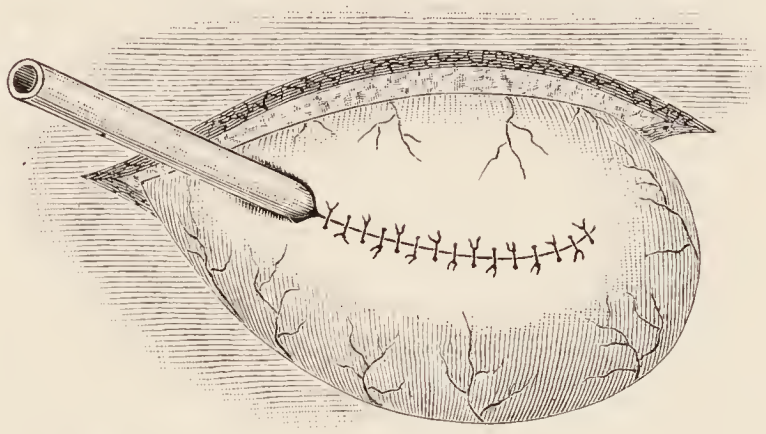


FIG. 947.

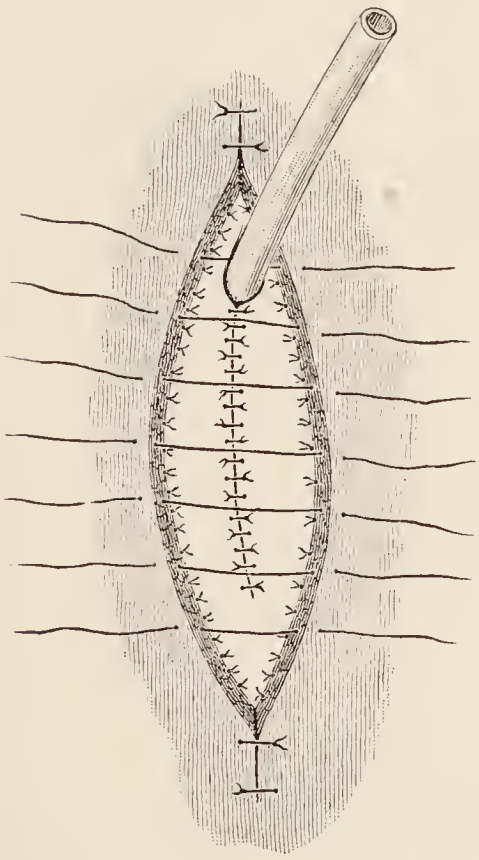


FIG. 948.

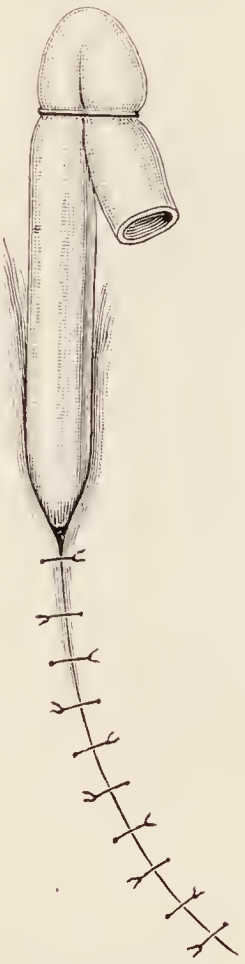


FIG. 949.

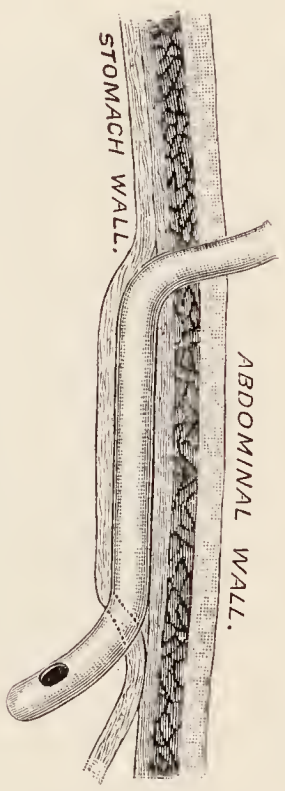



FIG. 950.

FIG. 946.—Witzel's method of gastrostomy, wrapping in the tube.

FIG. 947.—Witzel's method of gastrostomy, the tube wrapped in.

FIG. 948.—Witzel's method of gastrostomy, the stomach sutured in place and sutures laid to close the abdominal wound.

FIG. 949.—Witzel's method of gastrostomy, the abdominal wound closed and the tube constricted above.

FIG. 950.—Witzel's method of gastrostomy, a longitudinal view explaining the relation of the tube to the arrangement of the parts.

wrapped in for two or three inches of its length by uniting the walls of the stomach over it with several silk Lembert sutures, fortified, if need be, by a continuous row thereafter (Figs. 946 and 947). The stomach is allowed

to retreat sufficiently to permit the entire operation field to present at the wound, when its borders are closely united to the peritonæum and posterior layer of the sheath of the rectus by interrupted silk sutures (Fig. 948). The abdominal wound is then completely united by interrupted silkworm-gut sutures, and the tube, closed above by tying, or by a rubber band (Fig. 949), is fastened in position by a stitch. The tube is kept in place for three or four days until firm adhesions have ensued, the patient being nourished with nutritive enemata. After this time the patient is fed through the tube, which is at first introduced at frequent intervals to prevent undue closure of the opening. Later, however, the tube is employed only for the purpose of feeding; unless, as sometimes happens, the difficulty of reintroduction (Fig. 950) makes necessary permanent retention.

*The Results.*—While the special benefits attributed to this method are not always realized, still, the outcome compares favorably with that of other measures.

**Ssabanejew-Franck Method.**—*Kocher* credits Albert with this method, and regards it as being "the simplest and most reliable" one as modified by himself. Kocher carries the abdominal incision downward and outward

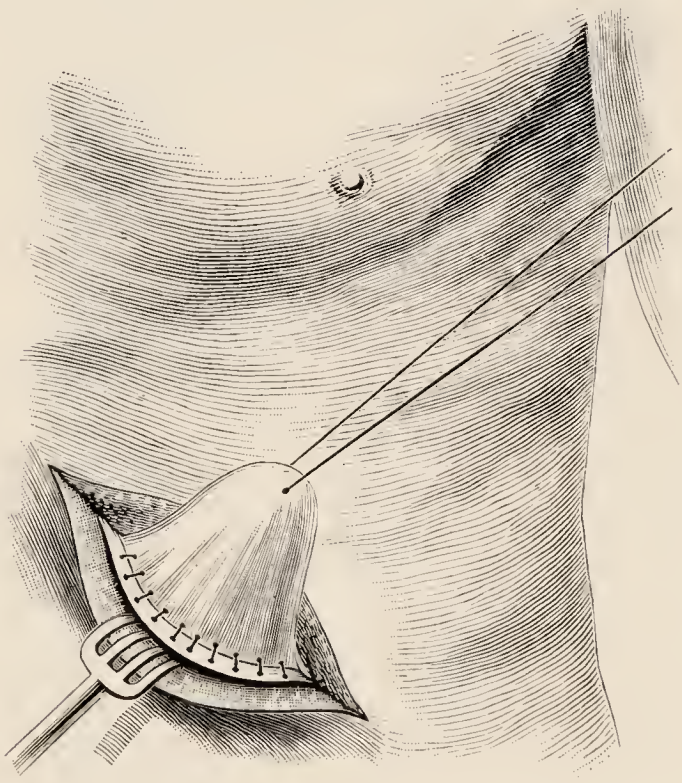


Fig. 951.

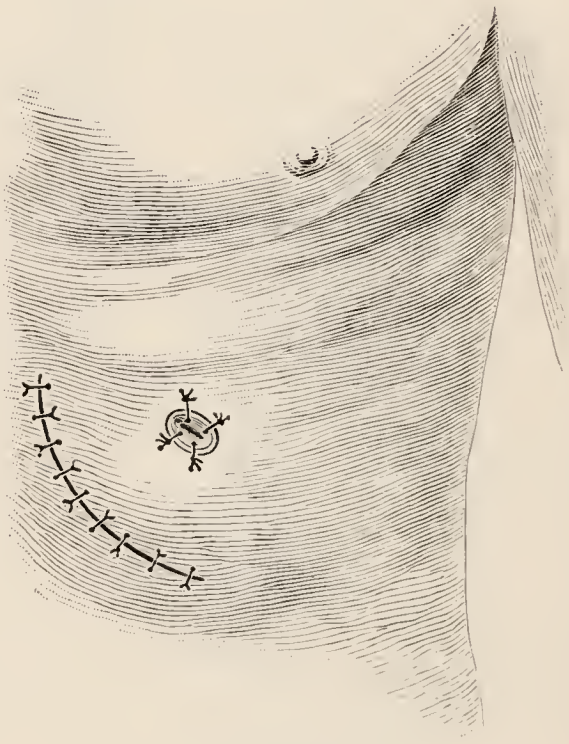


Fig. 952.

Fig. 951.—Ssabanejew-Franck method of gastrostomy, stomach drawn into the wound and sutured in place.

Fig. 952.—Ssabanejew-Franck method of gastrostomy, the lower wound closed and the borders of the opening stitched to those of the upper incision.

over the rectus muscle—more vertically than horizontally—about two inches from the margin of the costal cartilages; the muscular fibers of the rectus are separated vertically at the inner edge of the wound and drawn apart; the posterior wall of the sheath of the rectus and the peritonæum are divided, a long conical process of the stomach is drawn into the wound, and its base is united without much constriction to the deep borders of the wound by continuous or interrupted sutures, which include the serous and muscular coats of the stomach on the one side and the peritonæum and pos-

terior part of the sheath of the rectus on the other (Fig. 951). The founders of the method made the primary incision more oblique, and divided in the same direction fibers of the rectus muscle instead of separating them. A small incision is then made through the skin about an inch above the cartilages of the ribs, the intervening bridge of skin is undermined, and the apex of the diverticulum of the stomach is drawn upward under the skin and over the lower costal cartilages as far as the small skin incision, to the edges of which the apex is fastened by sutures (Fig. 952). A small opening is made at once into the apex of the protrusion, additional sutures are introduced at the borders, and the lower wound is closed with a continuous or interrupted suture.

*The Remarks.*—The success of this plan requires that the stomach be lax, and therefore not contracted or adherent, as it is liable to be from the effects of the various causes that demand gastrostomy, and, as sometimes happens, from prolonged starvation. The permanency of the fistula formed by this method contraindicates its employment in cases of œsophageal or gastric disease amenable to cure. This method of practice is hardly possible unless at least an inch and a half of the wall of the stomach can be drawn through the wound (Keen). The bending upward of the diverticulum and the grasping of its base by the separated fibers of the rectus muscle (Fischer) prevents the escape of fluids from the stomach and offers no obstacle to their introduction with a catheter.

**Hahn's Modification.**—*Hahn* gained access to the stomach by means of Fenger's incision, which is made about three inches in length and located to the left of the sheath of the rectus muscle, parallel with and about an inch below the costal cartilages (Fig. 963). He then made a superior incision through the eighth intercostal space close to the cartilages, perforated the intervening tissues with sharp-pointed hæmostatic forceps guided by the finger in the lower wound, seized the wall of the stomach with the forceps, drew it into the upper incision, joined the apex to the skin with sutures, and then finally closed the lower opening in the usual way.

*The Remarks.*—Hahn's modification offers no especial practical advantages to compensate for the increased danger attending its employment. The pleural cavity may be involved, and the efforts to obviate this danger may lead to injury of the cartilages and their subsequent necrosis. There is no reason to believe that the restraining influences of the cartilages are superior to the tissues utilized in other and safer plans of practice.

**Senn's (E. J.) Method.**—The basis principle of action of this method is the formation from the walls of the stomach of a circular valvelike structure near the surface, which readily permits of the introduction of food, yet aims to prevent the escape of fluid at all times.

*The Operation.*—Make the abdominal incision at the most desirable situation irrespective of the muscular structures, as their action is not needed in this method; grasp the anterior surface of the stomach near the greater curvature with the fingers or a suitable forceps, and draw a cone-shaped portion well upward into the opening, giving it in charge of an assistant; introduce, so as to include the serous and muscular coats of the stomach,

two and a half inches below the apex of the cone, two purse-string sutures of chromicized catgut (Fig. 953); draw them tightly, thus forming a neck (Fig. 954); raise up a portion of the gastrocolic omentum and suture it in a cufflike manner around the constriction with silk (Fig. 955); suture the stomach in place with silk so as to include its serous and muscular coats,

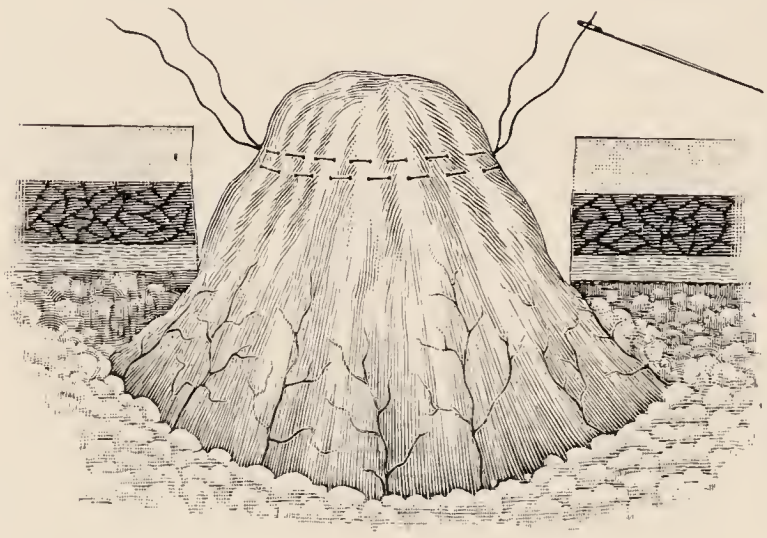


Fig. 953.

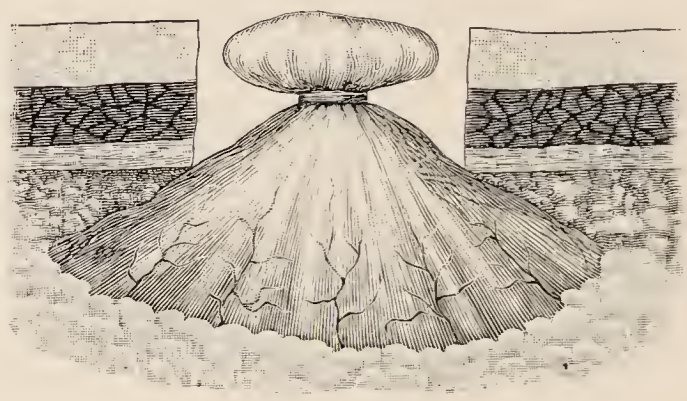


Fig. 954.

Fig. 953.—Senn's method of gastrostomy, the purse-string sutures placed.
Fig. 954.—Senn's method of gastrostomy, the purse-string sutures drawn tight.

the upper portion of the omental cuff, and all of the structures of the borders of the abdominal wound except the skin; close the skin with silkworm-gut sutures, leaving in sight the apex of the cone from which the valve is formed; make an incision at once, or later, as need be, about an inch and a half in length in the center of the exposed portion, and introduce through it a rubber tube into the stomach; invert the lips of the incision, and unite with each other the corresponding borders with silkworm gut in such a manner as to form a valvelike opening not more than half an inch in length (Fig. 956). The tube is employed only at the time of feeding. This method

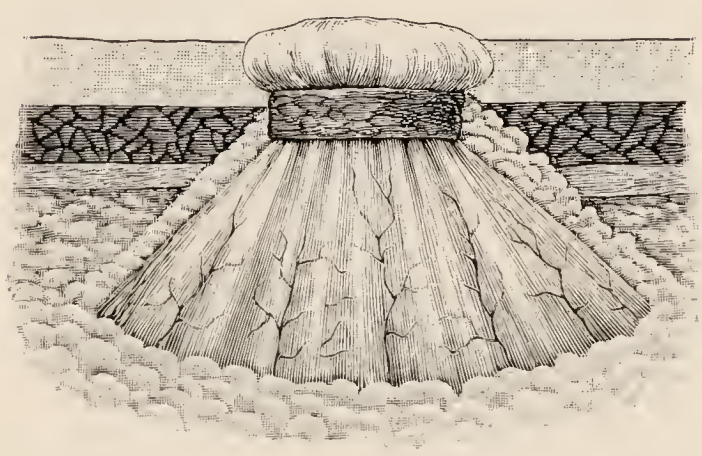


Fig. 955.

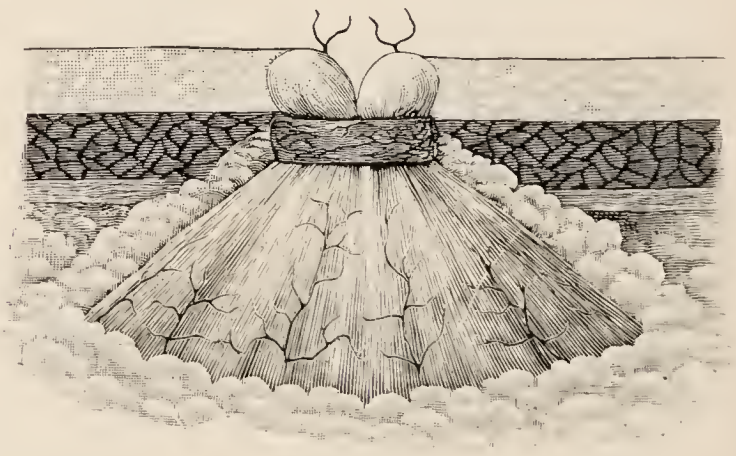


Fig. 956.

Fig. 955.—Senn's method of gastrostomy, the omental cuff applied and sutured in place.
Fig. 956.—Senn's method of gastrostomy, the apex of cone opened, inverted, and sutured in position.

is simple, readily and rapidly done, obviates leakage, and exposes the patient to comparatively little danger.

**Kader's Method.**—*Kader* was prompted to supply this method for a case not amenable to other plans of procedure because of a small and but slightly movable stomach. The plan is a modification of Witzel's, and is of broader

application because of the difference in the relations of the tube to the stomach.

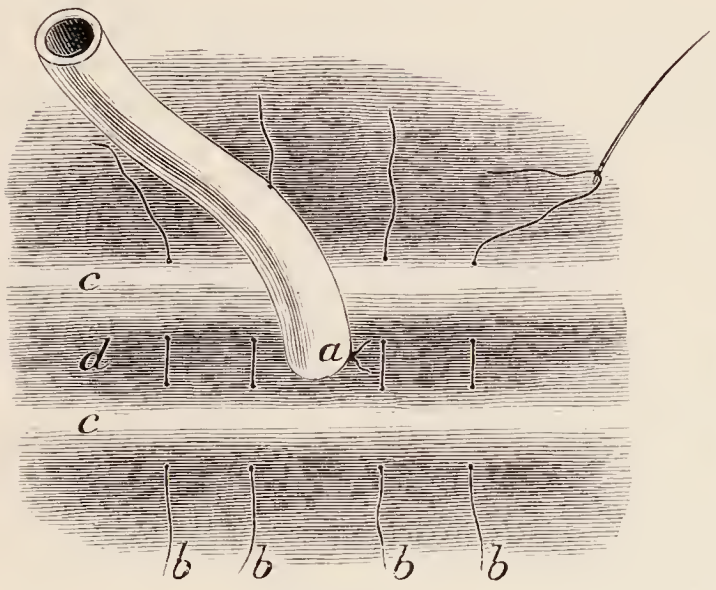



FIG. 957.

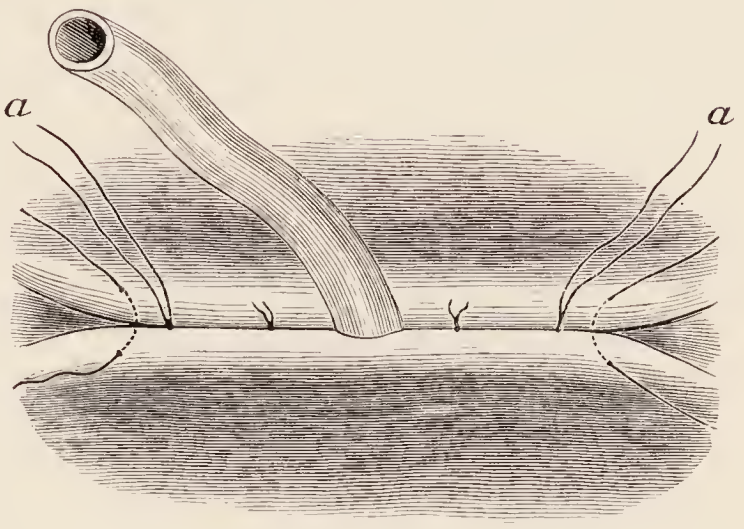



FIG. 958.

FIG. 957.—Kader's method of gastrostomy. Tube in place and fixed by suture (*a*). *b*, *b*, *b*, *b*. Infolding sutures. *c*, *c*. Primary transverse folds of stomach. *d*. Interval between folds.

FIG. 958.—Kader's method of gastrostomy. Sutures tied, ends of two (*a*, *a*) left long for better control, supplemental sutures placed at either end of infold.

*The Operation.*—Make the oblique or vertical abdominal incision, as suits the fancy of the operator or requirements of the case; separate the fibers of the rectus by blunt dissection, and divide the posterior wall of its sheath vertically in either instance; draw through the opening a fold of the stomach in the usual way, if its size and mobility will permit; pack the field with gauze; make a small incision into the stomach with a narrow bistoury; introduce through it into the stomach, for two inches, the end of a rubber tube the size of a pencil (Fig. 957); arrest bleeding, and fasten the tube to the stomach

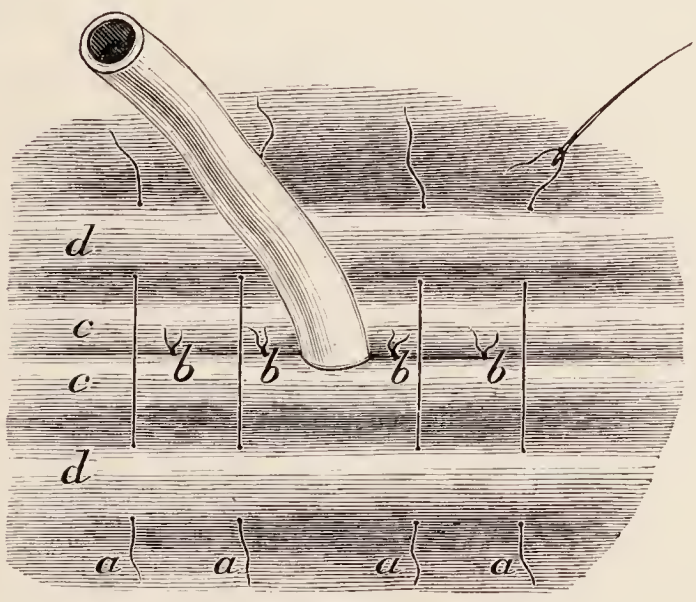



FIG. 959.

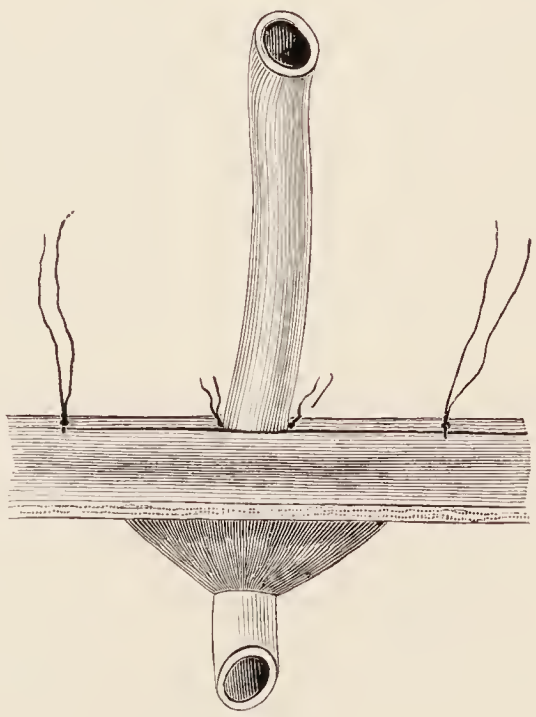


FIG. 960.

FIG. 959.—Kader's method of gastrostomy. *a*, *a*, *a*, *a*. Second row of sutures placed. *b*, *b*, *b*, *b*. Primary row to be covered in. *d*, *d*. Secondary transverse folds of stomach.

FIG. 960.—Kader's method of gastrostomy, second row of sutures tied and tube protruding inward with the stomach wall.

with a catgut suture (*a*); introduce at either side of the tube (*c*, *c*), so as to include the serous and muscular coats of the stomach, two silk Lembert

sutures half an inch apart (*b*, *b*, *b*, *b*), so placing them that each will include, at the extremes of an interval of three fourths of an inch, half an inch of corresponding portions (*d*) of the stomach; tie the sutures firmly (Fig. 958), drawing together the included tissue and thus forming two longitudinal folds; push into the stomach the infolded tissues, causing contiguous serous membrane to come in contact with the tube; unite together as before two additional folds, thereby covering in the preceding ones, and thus lengthening the canal in which the tube yet remains (Fig. 959); leave the sutures long for a time (Fig. 960), thus securing better command of the stomach; stitch the stomach to the denuded borders of the peritonæum and sheath of the rectus simultaneously; close carefully the external wound with sutures.

*Stamm* formed a canal of the wall of the stomach by drawing it around a catheter introduced vertically into that organ by means of a purse-string suture carried through the serous and muscular coats at a distance of about an inch from the catheter, then drawn tightly and tied.

*The Remarks.*—If the stomach can not be brought into the wound on account of its small size or the presence of adhesions, deep occlusion sutures are employed to draw it up and unite it to the opening, thus closing the peritoneal cavity. If this measure fails, the stomach is opened in the abdominal cavity. *Meyer* has met with an instance of this kind. Perpendicular folds of the coats of the stomach should be formed in permanent fistula; the transverse in the temporary. On removal of the tube the opening is guarded by the valvelike infolding of the stomach wall.

*The Results.*—Thus far the outcome from this method is very good. In ten cases operated on by Mikulicz all made satisfactory recovery.

**Andrew's Method.**—This method can be practiced by making a vertical incision through the anterior wall of the stomach two inches in length, through which a portion of the wall immediately below is drawn upward and exposed, with the mucous membrane uppermost. The tube is then placed on this membrane in the line of the incision into the stomach, and the membrane only is divided at either side of and parallel with the tube at such a distance that the strip of membrane thus formed will surround the tube when its borders are united. The distal borders of this incision are then brought over the already covered tube and united by sutures. The gastric wound is closed, the stomach connected to the abdominal wall, and the external opening closed around the tube in the usual manner. Practical experience in the use of this method is required to establish its comparative value and freedom from seemingly difficult if not dangerous operative technique.

**Marwedel's Method.**—The stomach is exposed through the oblique incision, united to the abdominal wound, and the serous and muscular coats are divided obliquely for about two inches down to the mucous membrane, which is then perforated at the cardiac end, the end of the tube inserted into the stomach (Fig. 961), and the remainder covered over by union of the borders of the serous and muscular coats with a buried suture, and the external wound is closed (Fig. 962).

*The Results.*—The results thus far (five in number) are flattering—four recovered, and one died on the following day from the effects of inanition.

*The choice of operation* will depend very much, indeed, on the condition of the patient, the size and mobility of the stomach, and whether or not a permanent canal is required. The condition of the patient permitting, and a permanent opening being required, the Ssabanejew-Franck method as modified by Kocher is all that can be desired. If it be found that the

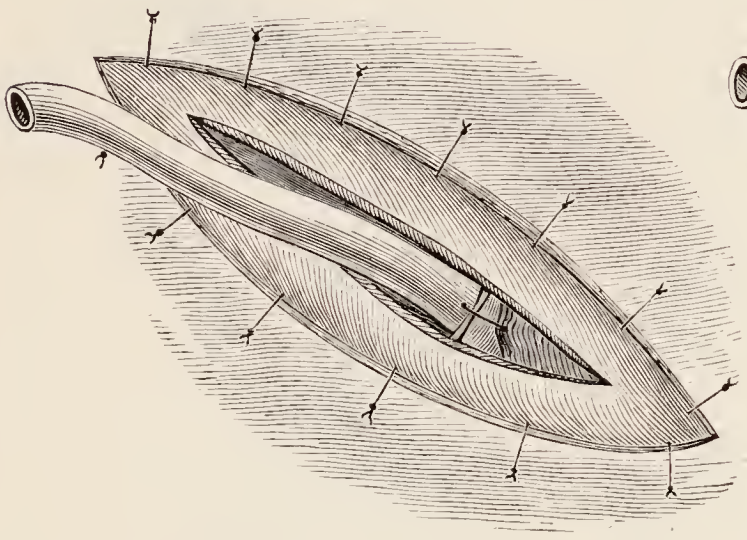


FIG. 961.—Marwedel's method of gastrostomy. Incision made, tube inserted and stitched in place.

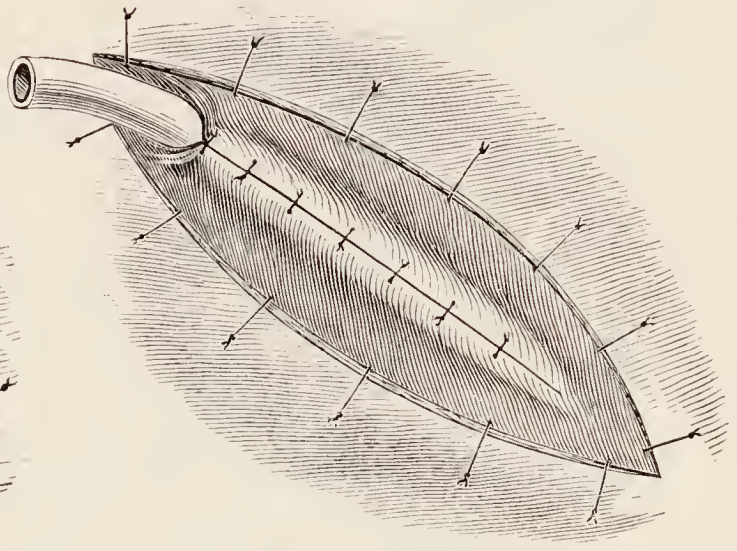


FIG. 962.—Marwedel's method of gastrostomy. Tube covered by suturing together muscular and serous coats.

stomach is small or adherent, an exchange for the plan of Kader or Witzel may be made with satisfactory results. If a temporary opening be in view and the conditions of the patient are favorable, the method of Senn, of Marwedel, and even the older plan first described, can be practiced. If the condition of the patient is precarious, as is too often the case, the older method only may be advisable. It seems proper to say in this connection that one should select that method of practice with which he is most familiar, provided, of course, other things are equal. The employment of cocain anæsthesia is commended in those instances of exhaustion requiring haste and simple technique and those unsuited for general anæsthesia.

**Gastro-enterostomy.**—Gastro-enterostomy signifies the establishment of a permanent fistula between the stomach and some part of the small intestine to secure proper emptying and rest of the stomach. Therefore, the nomenclature of the operation can be extended to conform to the special part of the small intestine concerned in the procedure, as gastro-duodenostomy, gastro-jejunostomy, gastro-ileostomy, etc.

*The Anatomical Points.*—The relations of the greater and lesser abdominal sacs to the stomach, transverse colon and its mesocolon, the jejunum, and the duodenum, and the arrangement of the great omentum, should be considered carefully before beginning the operation (Fig. 940). Only a brief mention of the most striking points can be given here for obvious reasons. The anterior wall of the stomach is in the greater, the posterior in the lesser sac. The inferior wall of the transverse colon is in the former, the superior wall in the latter sac, and the transverse mesocolon separates the two horizontally. The mesentery extends downward from beneath the transverse mesocolon near its attachment—ligament of Trietz (Fig. 964)—at which point the beginning of the jejunum is located. The great omentum

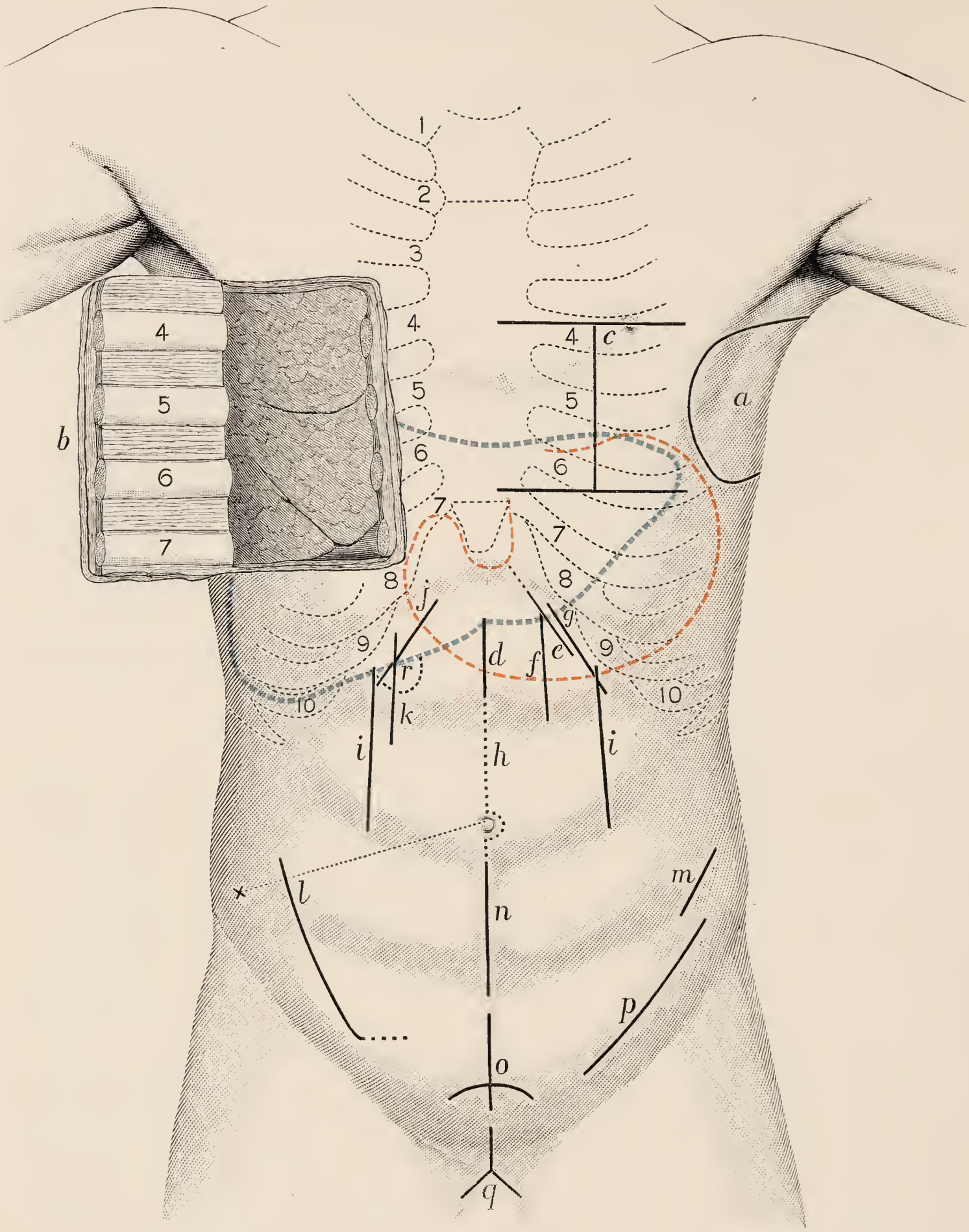



FIG. 963.—Diagram of incisions of important operations (schematic).

*a*. Lambeau's flap in thoracoplasty (page 1029). *b*. Delorme's flap in thoracoplasty (page 1030). *c*. Delorme-Mignon's incision in approach to heart (page 1056); blue dotted lines indicate outlines of liver; red dotted lines indicate outlines of stomach. *d*. Incision in gastrotomy (page 739). *e*. Howse's incision in gastrostomy (page 743). *f*. Jacobson's incision in gastrostomy (page 743). Dotted line above + *e* corresponds to Witzel's incision in gastrostomy (page 746). *g*. Fenger's incision, utilized in Hahn's modification (page 749). *h*. Dotted line + *d* corresponds to incision in posterior gastroenterostomy. *i*, *i*. Langenbüch's incision at right and left sides for abdominal exploration of kidneys (page 838). *j*. Courvoisier's incision in operation on gall bladder and ducts (page 803 *et seq.*). *k*. Vertical incision through outer fibers of rectus in operations on gall bladder. *l*. Meyer's hockey-stick incision, and the imaginary line noted in removal of appendix (page 725 *et seq.*). *m*. Incision in iliac colostomy (page 675). *n*. Incision in median line in cœliotomy below navel (page 608 *et seq.*). *o*. Vertical and transverse oval (Trendelenburg) incisions in epicystotomy (page 1122). *p*. Incision in Bassini's operation for radical cure of hernia (page 915 *et seq.*). *q*. Langenbeck's incision in subpubic entrance to bladder (page 1122). *r*. Gall bladder.

hangs from the greater curvature of the stomach and the lower surface of the transverse colon, covering over the latter. The omentum may be hollow, the cavity communicating with the lesser sac above the colon; more often its layers are adherent to each other. It varies in density: is sometimes thick, again extremely thin, even diaphanous. It may be smooth, roughened, often crumpled, and either free or adherent to the intestines beneath. It can be carried upward over the colon and stomach or to one side, more easily to the left. These simple facts exercise an important bearing on the manipulation of the structures. The jejunum must not be confounded with the ileum. The former is of a brighter color, denser and smoother in struc-

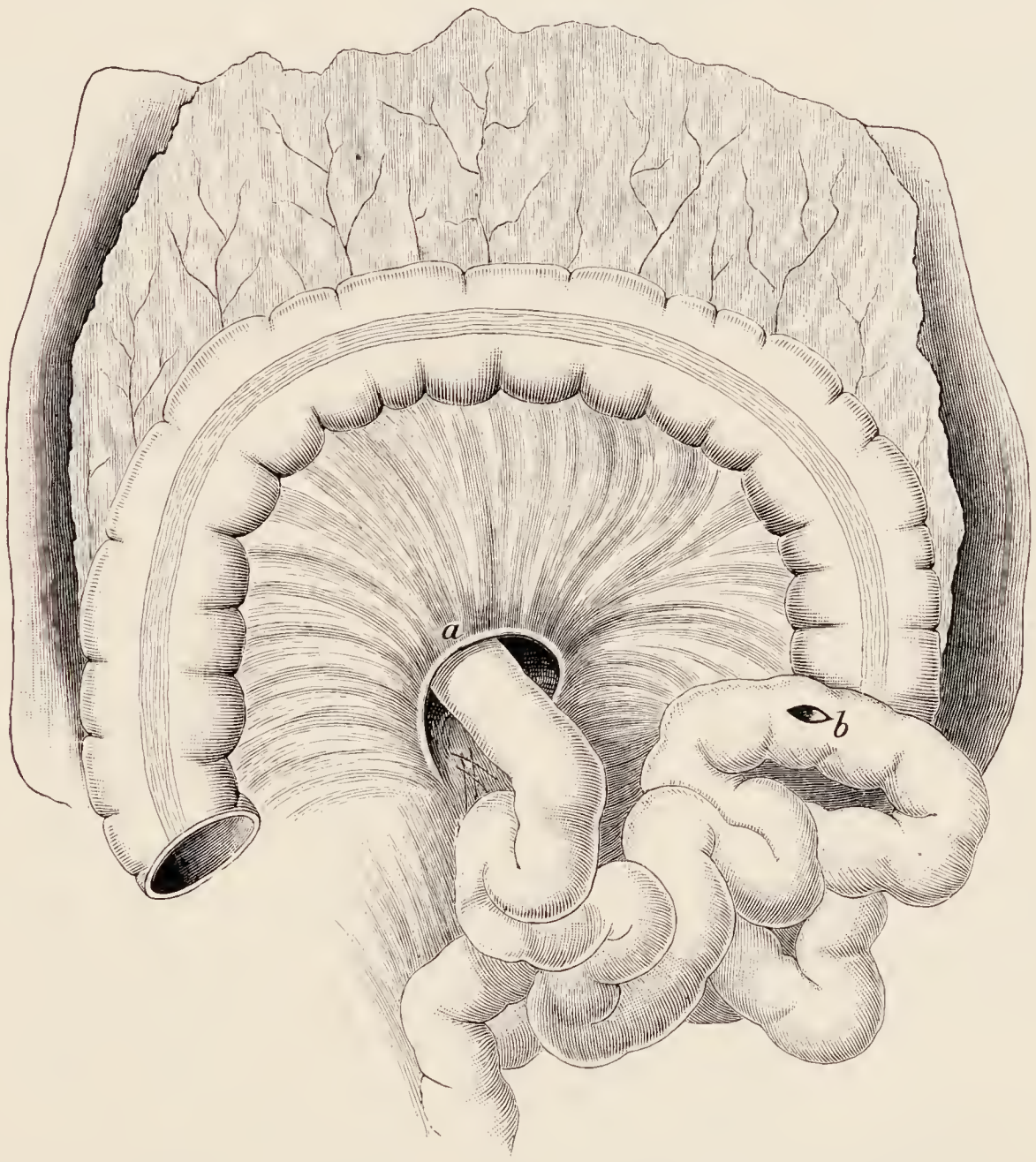



FIG. 964.—The operation of gastro-enterostomy. *a*. Ligament of Trietz. *b*. Opening into jejunum.

ture, and of a greater capacity than the latter; its walls also are thicker, and the root of its mesentery is higher. The jejunum is readily seized by passing the thumb and finger along the under border of the transverse mesocolon to its root and grasping the first intestinal loop that is felt immediately below. If this intestine be pulled toward the wound in a limited degree, the movement is arrested by the intestine's connection with the immovable part of the duodenum. If pulled so as to make traction on the opposite extremity of the loop, arrest does not happen because of its continuity with the remainder of

the movable small intestine. Although not anatomical, it is needful to note that the flow of digestive matter in the stomach is principally along the greater curvature, from the cardiac toward the pyloric extremity, and that the reverse is the course at the lesser curvature of the stomach. In the

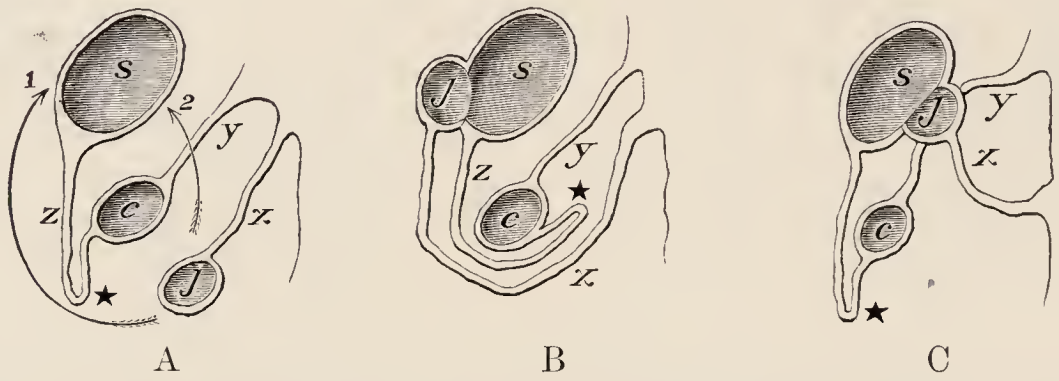



FIG. 965.—The operation of gastro-enterostomy. Scheme of relations in the attachments of the jejunum to the stomach.

*s*. Stomach. *c*. Transverse colon. *j*. Jejunum.
*z*. Gastro-colic omentum. ∗. Great omentum. *y*. Transverse mesocolon.
*x*. Mesentery.
A. *1*. Course of jejunum to anterior surface of stomach.
*2*. Course of jejunum to posterior surface of stomach.
B. Relations of parts in anterior gastro-enterostomy.
C. Relations of parts in posterior gastro-enterostomy.

cardiac two thirds of the organ the food is propelled in a uniform gentle manner in the directions above stated. At the pyloric third it is more pultaceous, and is expelled into the small intestine in an intermittent and somewhat forcible manner. In the intestine the course is downward along the canal. These facts are of importance in the technique of union of the intestine with the stomach in the absence of special provision to neutralize the influence of the contact of opposing currents at the seat of anastomosis. *Two varieties of procedure have been devised, known respectively as anterior and posterior gastro-enterostomy.* In the former, the small intestine is passed in front of the transverse colon and joined to the anterior surface of the stomach (Fig. 965, B); in the latter the intestine is carried either through the transverse mesocolon or gastro-colic omentum and united to the posterior surface of the stomach (Fig. 965, C). An objection to the former method (Fig. 966), though easier of attainment, is the stronger tendency to regurgitation of the intestinal contents into the stomach; to the latter, the greater difficulty of joining the parts, and the greater danger of peritoneal infection and of kinking of the intestine on account of the influence of the tissues through which it passes. The regurgitation into the stomach of intestinal contents happens from the proximal end of the intestine in one of two ways: 1, The opposing currents fill the intestine directly, which finally expels its contents into the stomach; 2, the fluids may gain the intestine by way of the pylorus, and whether

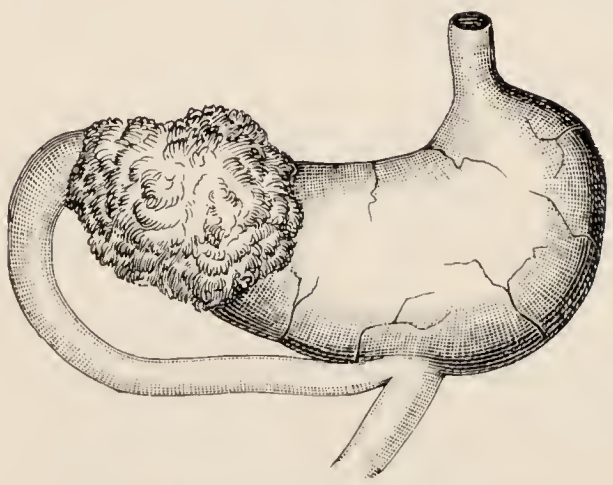


FIG. 966.—Gastro-enterostomy (diagrammatic).

added to or not by direct reception from the stomach, they are expelled into the stomach the same as before.

The prevention of the entrance into the stomach of the intestinal contents and entrance of the products of the former to the intestine are promoted by the following plans of action: 1, By union of a half-twisted loop of intestine with the stomach (Fig. 967), thus causing a similarity in the direction (left to right) of the flow of the contents of the united organs (Rockwitz). Unfortunately, however, the anticipated benefit was not fully realized, because the curve fashioned by the operation disappeared with return to the abdomen of the parts, and was soon followed by the development of a spur at the seat of union which caused a short-circuiting of the fluids through the stomach and proximal limb of the bowel; also,

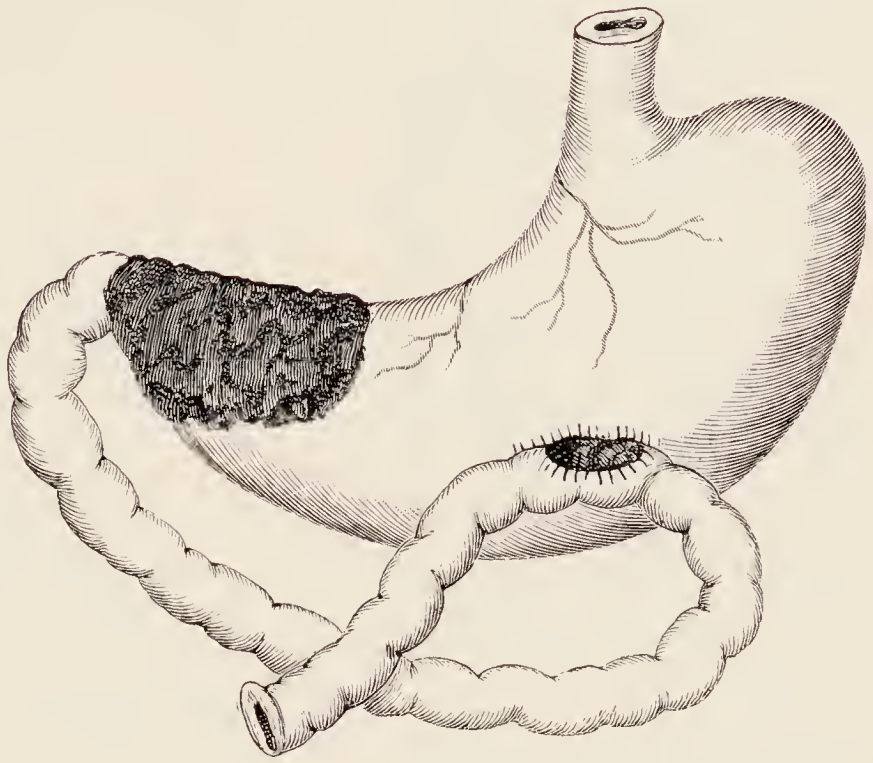


Fig. 967.—The operation of anterior gastro-enterostomy. Union of a half-twisted loop with stomach.

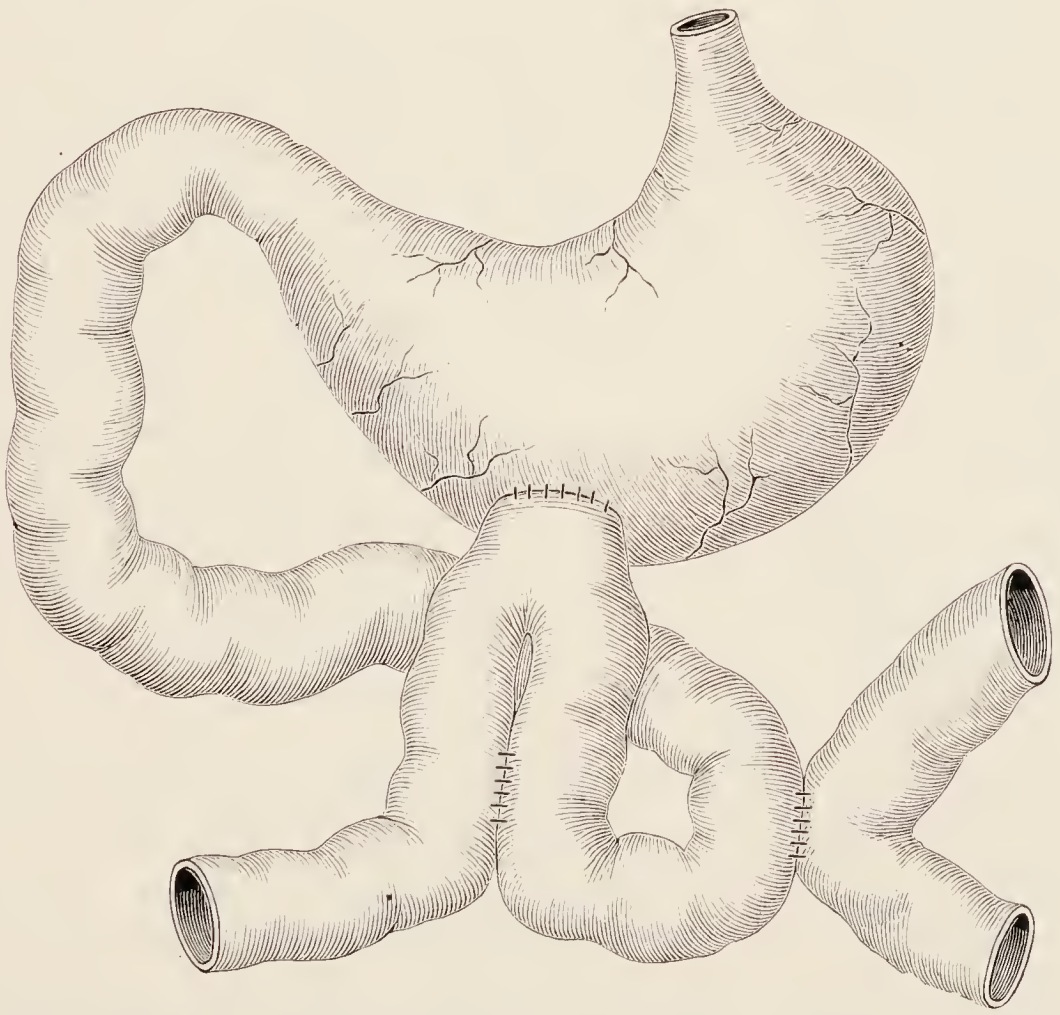


Fig. 968.—The operation of anterior gastro-enterostomy. Entero-anastomosis, Braun's method.

great distention of the duodenum happened not infrequently, and, furthermore, the constriction incident to the pressure of the loop overlying the

colon (Fig. 965, B) was regarded with disfavor. 2, By multiple anastomosis (entero-anastomosis) (Braun); 3, by valve formation and compression adjustment of the parts (Kocher); 4, by posterior gastro-enterostomy (Von Hacker).

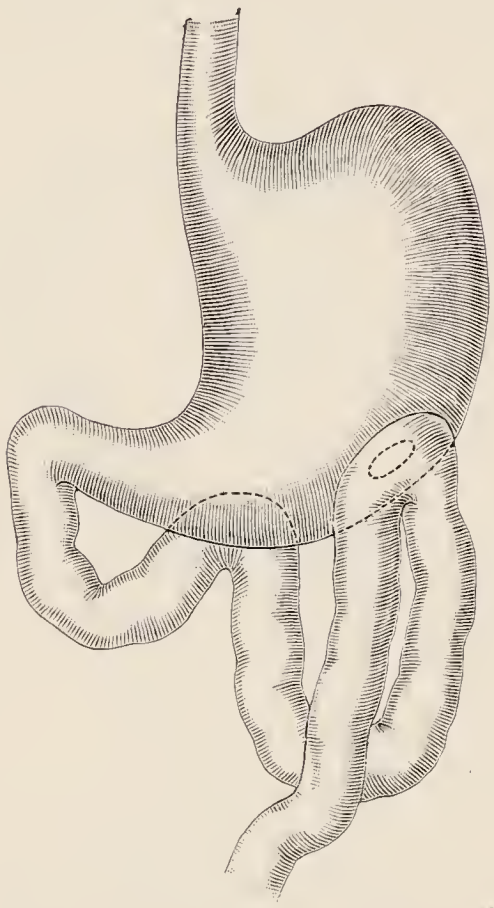


Fig. 969.—The operation of anterior gastro-enterostomy. Entero-anastomosis at point of intestinal crossing, Lowenstein's method.

*Entero-anastomosis* (Braun).—Entero-anastomosis is practiced in gastro-enterostomy to cause the discharge of the contents of the proximal part of the intestine into the general intestinal current so far below the point of junction of the stomach with the intestine as to divert its course from the latter situation (Fig. 968). When connected in the manner indicated in the cut, the contents of the duodenum are short-circuited through two channels—viz., into the jejunum below the point of union with the stomach, and also into the contiguous loop of intestine at the left side of the same point. At the same time the union of the loops of viscera harmonizes the direction of the flow. Lowenstein (Fig. 969) and Jaboulay (Fig. 970) made a second anastomosis (entero-anastomosis) lower down, followed by Wölfler with his later plan (Fig. 971). The functional advantage gained by the use of either of these methods is

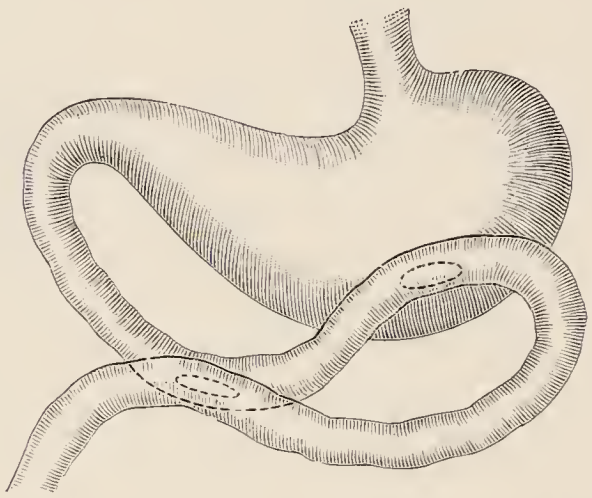


Fig. 970.—The operation of anterior gastro-enterostomy. Entero-anastomosis, Jaboulay's method.

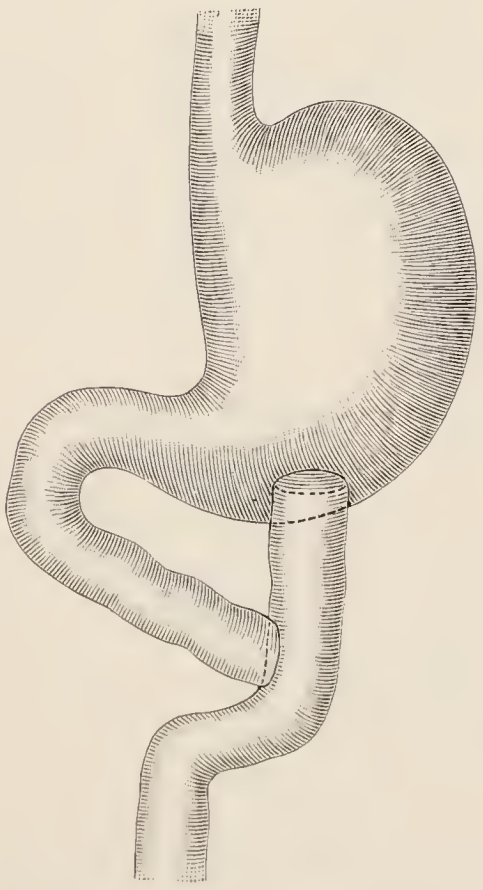


Fig. 971.—The operation of gastro-enterostomy. Entero-anastomosis, Wölfler's later method.

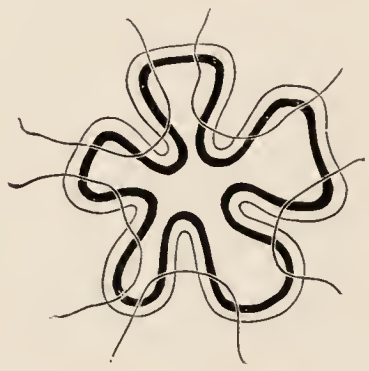


Fig. 972.—The operation of anterior gastro-enterostomy. Narrowing of proximal of bowel by means of transverse sutures, Von Hacker's method.

too often an inadequate recompense for the depressing effect on the patient of the longer time employed and the greater danger incurred from infection

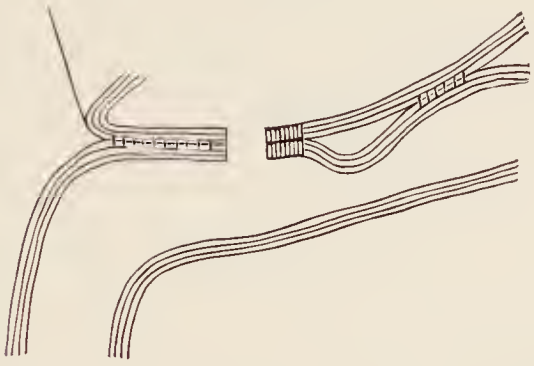


FIG. 973.—The operation of anterior gastro-enterostomy. Narrowing of the pylorus and duodenum, Doyen's method. Longitudinal section.

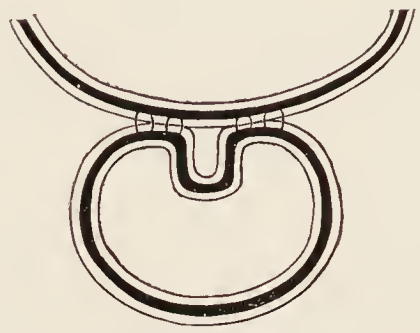


FIG. 974.—The operation of anterior gastro-enterostomy. Narrowing of the pylorus and duodenum, Doyen's method. Transverse section.

by the adoption. Not a few attempts directed to the gut have been proposed to prevent the reflux of the stomach contents into the proximal part of the bowel. The methods of Von Hacker (Fig. 972), Doyen (Figs. 973, 974), Chaput (Fig. 975), and Kocher are each commendable for their ingenuity, but Kocher's only contributes sufficiently to commend employment when posterior gastro-enterostomy can be practiced.

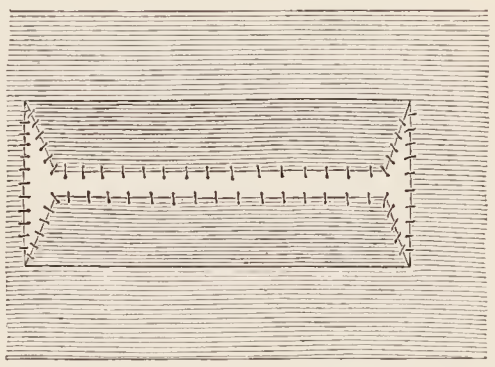


FIG. 975.—The operation of anterior gastro-enterostomy. Valve between stomach and intestine, Chaput's method.

**Kocher's Method.**—After thorough cleansing of the stomach by means of a boric-acid or other suitable solution, and aseptic treatment of the operation field, make an incision in the median line four to six inches in length down to the peritonæum; arrest hæmorrhage; divide the peritonæum the full length of the incision; introduce through the entire thickness of each border of the wound one or more strong traction sutures; push the omentum upward or to the left; pass the fingers beneath the transverse colon along the under surface of the transverse mesocolon, and seize the nearest loop of intestine as already described. Draw the loop into the wound and determine its identity after the method adopted for recognition of the jejunum (page 755); place the end of the loop, which is formed at a point about sixteen inches from the beginning of the jejunum, against the anterior surface of the stomach near the middle, so that "the proximal portion of the loop ascends and the distal portion descends" (Fig. 976); suture the proximal part of the loop to the stomach, allowing the distal part to lie freely upon the proximal; form a valve in the distal part of the intestine near the stomach by making a curved incision through it for about half of its circumference, the flap thus made having a transverse base with convexity upward; unite the outer surface of the base of the valve with the lower edge of the wound in the stomach, the convex border remaining free. Join the upper border of the opening in the stomach with the concave border of the opening in the intestine resulting from the valve formation. Interrupted or continuous

silk sutures are employed for these purposes; usually the former and sometimes both together. The mechanism of valve formation and compression adjustment is explained by Kocher as follows: "The valve forces the escape of the stomach contents into the distal part of the intestine and prevents the entrance into the stomach of the contents of the proximal segment of intestine by directing them along into the distal portion. The compression of the distal part while in active use closes the underlying proximal end at the seat of union, which is in turn readily opened by the escaping contents of the proximal part when the distal is not in action." During the entire procedure immunity from infection incident to the making of the openings into the stomach and intestine, and from other steps of the procedure, is guarded against by gauze packing properly arranged around the abdominal opening, and by the exclusion of visceral contents from the sites of the incisions by digital manipulation and pressure. After thorough cleansing of the parts with the warm saline solution they are cautiously inspected for the presence of faulty sewing before being returned to the peritoneal cavity. The abdominal wound is then closed and dressed in the usual manner, and the patient is returned to bed.

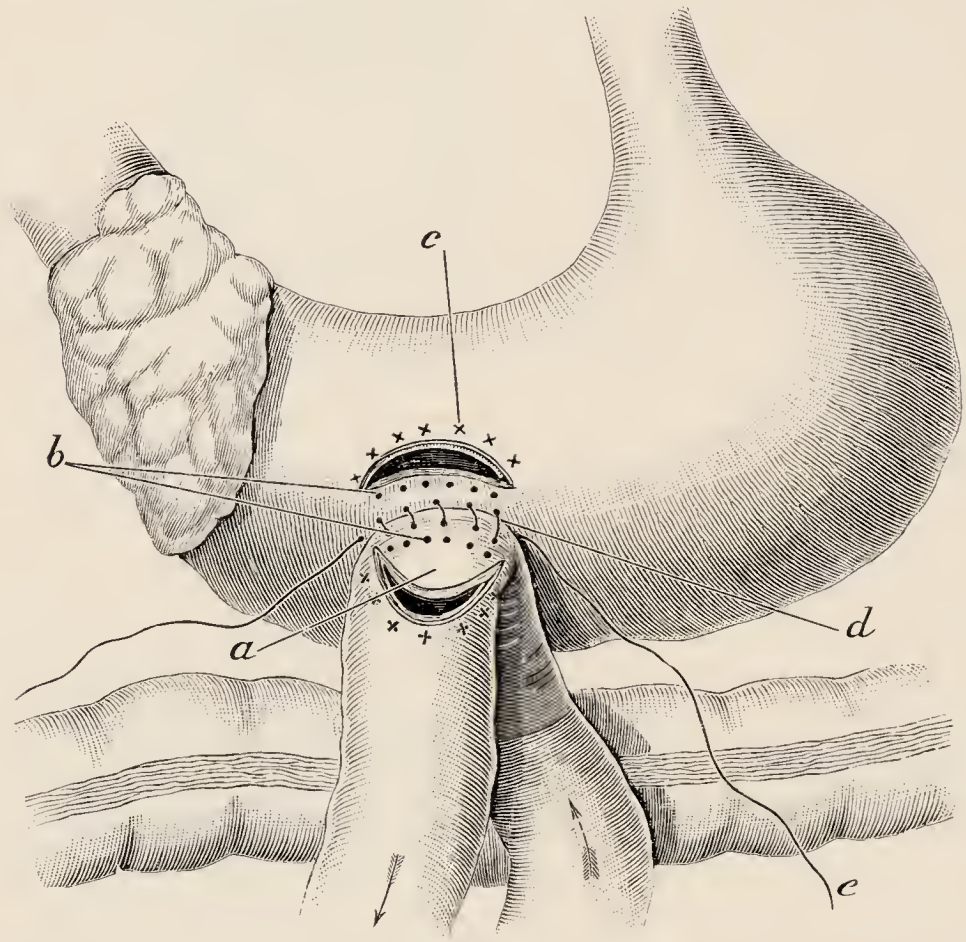



FIG. 976.—The operation of gastro-enterostomy, Kocher's method. *a*. Valve formed from jejunum. *b*. Location of sutures of posterior segment. *c*. Location of sutures of anterior segment. *d*. Posterior continuous suture. *e*. End of posterior suture left for use as anterior suture.

*Braun* recommends a more precise method of union by joining with each other the borders of the respective tissues of the viscera as soon as they are divided. First unite the intestinal loop with the stomach by a long posterior continuous suture carried through the serous surfaces only, both ends being left long. Make an incision at the proper place through the serous and muscular tunics only of the organs, and unite the severed borders posteriorly with each other by an independent suture; press aside the contents of the stomach and intestine with the fingers, holding the parts securely in position; open into the intestine and stomach by division of their mucous membranes, and unite the borders of the mucous membranes with each other by a continuous anterior mucous-membrane suture; introduce a second anterior suture, which passes through the entire thickness of the walls of the respective viscera; and, lastly, introduce a final anterior

musculo-serous suture, which is formed by utilization of the ends of the long posterior serous suture before described.

**Sonnenberg's Method.**—Pass through and fasten to the borders of the incision into the stomach at short intervals numerous long silk sutures; make an incision into the long axis of the small intestine, and sew its borders with an overhand continuous suture of catgut (Fig. 977); make another opening into the small intestine, an inch or so below the former; introduce the ends of the gastric sutures into the primary intestinal opening, carry them out through the secondary intestinal one, and by gentle traction on them bring the borders of the gastric and intestinal openings in contact with each other (Fig. 978); they are united together in this position by silk sutures applied in the usual manner. It should be noted that the method recalls Maunsell's (Fig. 809) in one essential particular—the long sutures. The ingenuity of these methods surpasses considerably their present practical utility when compared with more modern plans of procedure.

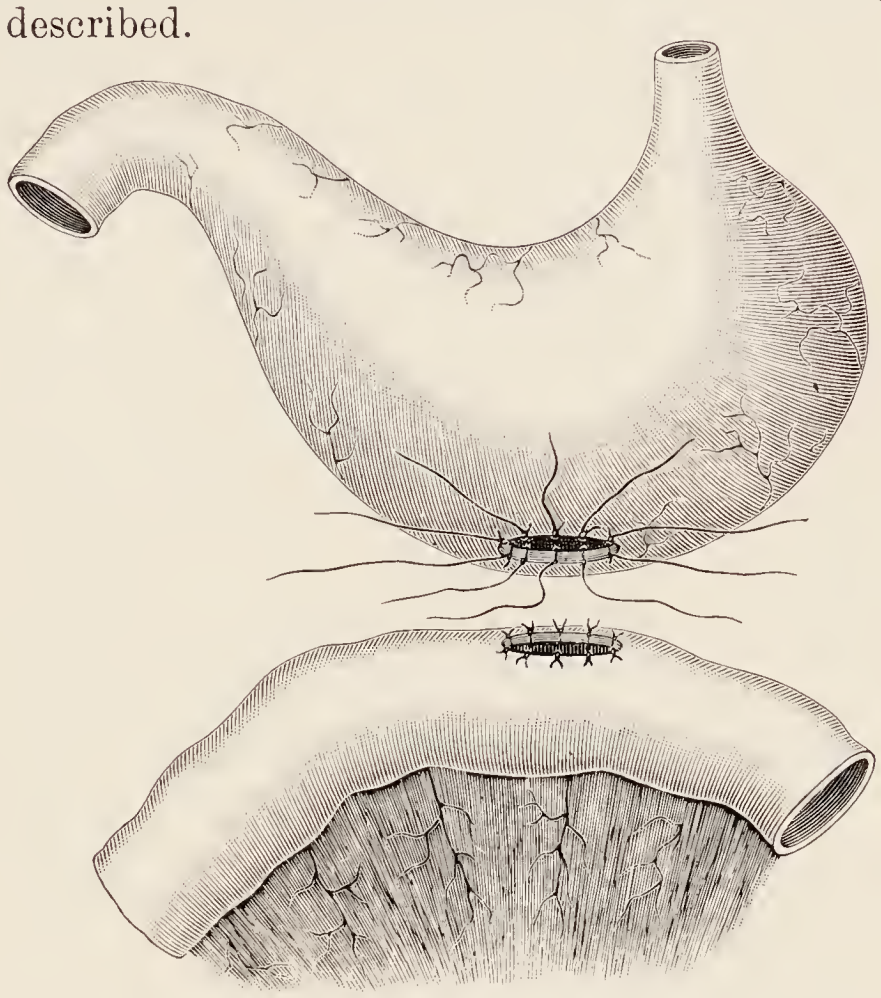


Fig. 977.—The operation of gastro-enterostomy, Sonnenberg's method. Sutures in place.

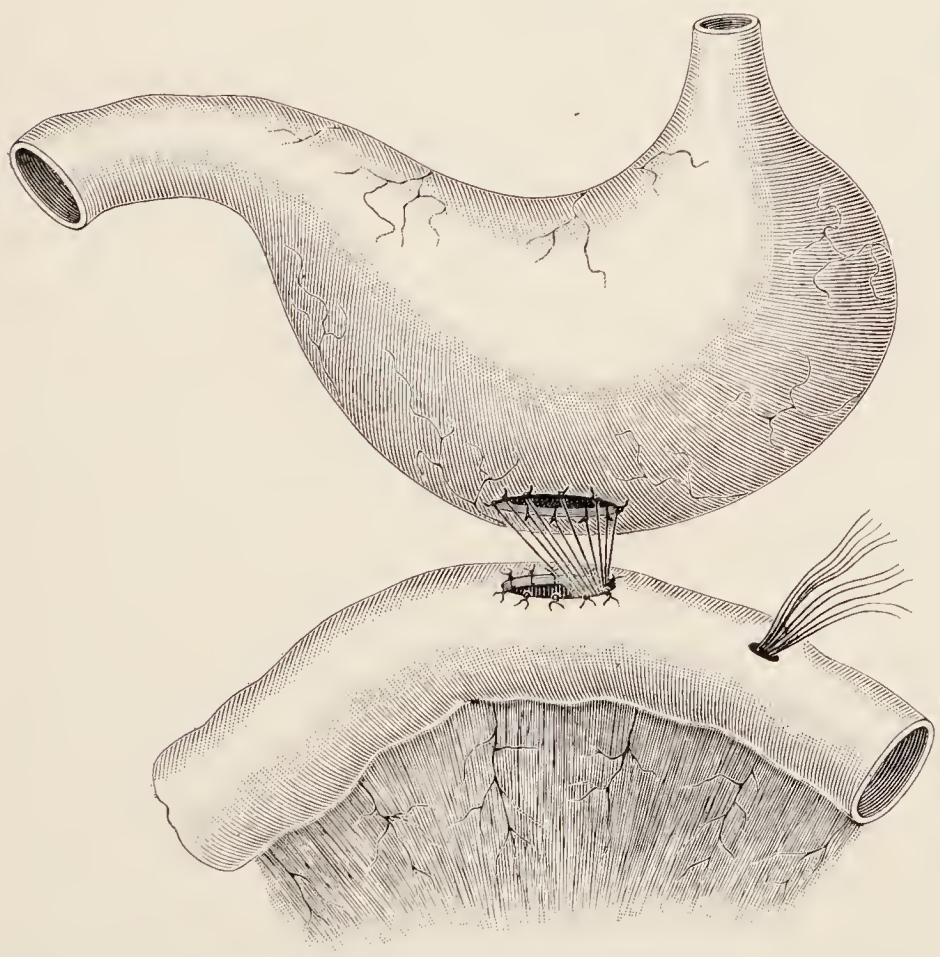


Fig. 978.—The operation of gastro-enterostomy, Sonnenberg's method. Sutures ready for approximation.

**Posterior Gastro-enterostomy** (Von Hacker).—After the usual gastric preparation and other preparatory steps, make an incision in the median line from a point two inches below the xiphoid cartilage to a point below the umbilicus (Fig. 963), increasing thereafter the length in either direction as may be required; raise and push upward over the

stomach the omentum and the transverse colon (Figs. 979 and 965, C), and hold them in place with sterilized gauze compresses; recognize and isolate the beginning of the jejunum; cause an assistant to so grasp the stomach with both hands that the fingers will be applied to the posterior and the thumbs to the anterior surface of the organ; pronate the forearms, thus pressing the posterior wall downward and upward against the transverse mesocolon; slit the mesocolon parallel with its vessels at the point of proposed entrance to the stomach with forceps; cause the stomach to protrude through the slit by pressure of the thumbs, and promptly stitch the separated borders of the slit to the posterior wall of the stomach (Fig. 980); push aside the contents of the first loop of the jejunum for the distance of six or eight inches, with the thumbs and fingers, and apply proper clamps to prevent their return; apply, with or without looping (Figs. 979, 980), the empty segment of gut to the posterior wall of the stomach, and unite these with each other at the lower border by means of sutures passed through the sero-muscular coats only; open the stomach obliquely downward from left to right for two inches; open the intestine in the long axis of the free border a similar distance, and unite the borders of the respective openings with each other in the usual manner by sewing; remove the proximal intestinal clamp, and narrow this part of the intestine near the anastomosis by infolding the walls longitudinally in several places, and confining them in this position by sutures passed through the sero-muscular coats of the projecting borders, thereby forming a rosette outline of the lumen of the gut at this situation (Fig. 972). Entero-anastomosis may be practiced instead (page 758). The parts are then cleaned thoroughly, the protective packing is removed, the viscera are returned into place, and the abdominal wound is closed by tier suturing.



Fig. 979.—The operation of posterior gastro-enterostomy. Jejunum looped to secure uniformity of peristalsis, Von Hacker's method.

*The Remarks.—Von Hacker* claimed that the facility of procedure and freedom from the danger of peritoneal infection when the parts are thus manipulated are equal to those in the method of union at the anterior surface of the stomach, and that the liability to intestinal kinking and regurgitation of intestinal contents into the stomach is reduced to a minimum for all operations, which subsequent experience has confirmed. The contentions of many others that the manipulations of the stomach in this method being

harsh at the best, and the opportunity for proper union of the viscera and prevention of peritoneal infection being greatly hindered, thereby neutralizing the additional advantages gained in favor of this method of practice, have not proved true. Certainly, the uniformity in the direction of the flow of the contents of the viscera, and their more natural position, together with the influence of the force of gravity on the contents of the stomach, emphasize the wisdom of this method. Practically the influence of gravity seems sufficient to meet the requirements, as direct anastomosis (Fig. 980) is now quite commonly employed with satisfactory results. Transverse division of the mesocolon should be avoided, because of the great liability of injury to the vascular supply of the colon and the danger of subsequent gangrene. Cautious and effective suturing of the stomach to the separated borders of the opening in the mesocolon prevents undue traction on the intestine and the occurrence of a slit through which the intestine may escape with dangerous results. The employment of a medium-sized Murphy button (page 765) to unite the intestine with the stomach, and a small one for entero-anastomosis, has shortened the time of the operation so much that its scope has been considerably extended and the results much improved. The making of an opening through the gastro-colic omentum is not a matter of trifling significance.



FIG. 980.—The operation of posterior gastro-enterostomy. Transverse colon and omentum turned up, transverse mesocolon slit sutured to stomach, and intestine directly united to stomach, Von Hacker's method.

**Roux's Method.**—*Roux*, after turning up over the stomach the great omentum and the transverse colon, made an opening through the posterior border of the transverse mesocolon a little to the left of the median line of the vertebral column, thus exposing the stomach near the pyloric end. The jejunum was then divided several inches from the plica duodeno-jejunalis (Fig. 981), the distal end of the bowel implanted by sewing into the posterior surface of the stomach (*c*), and the proximal end (*a*) united in the same manner with the distal at a point below the connection of the latter

with the stomach (*b*) (Fig. 981). The employment of the Murphy button in this instance would no doubt greatly facilitate the operation.

*The Precautions.*—As complete isolation as is possible of the operation field by aseptic packing and use of rubber dam should be practiced in gastro-

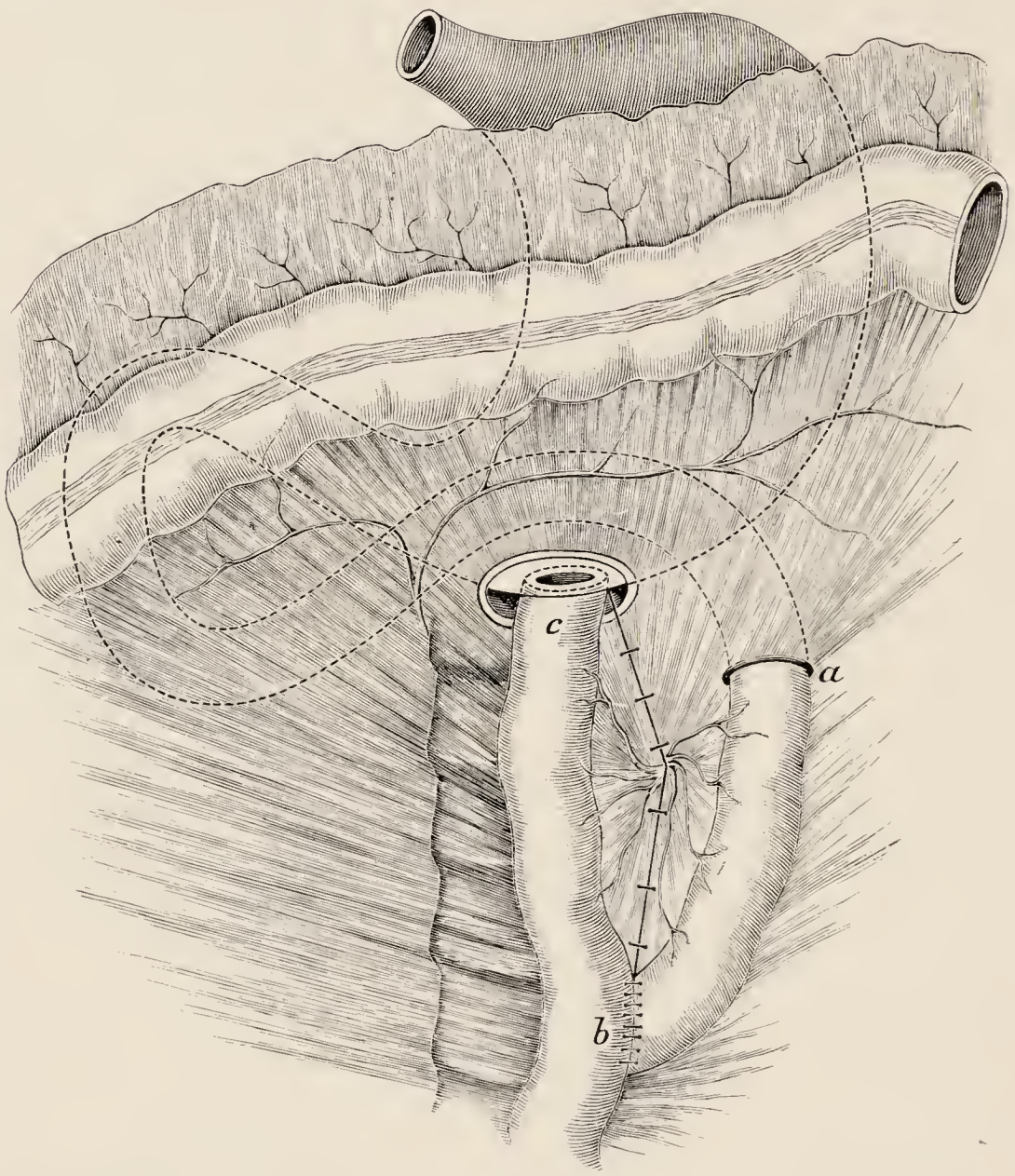



FIG. 981.—The operation of posterior gastro-enterostomy, Roux's method. *a*. Proximal end of jejunum. *b*. Union of proximal and distal ends of jejunum. *c*. Distal end of jejunum joined to pyloric portion of stomach.

enterostomy to prevent peritoneal infection. The occurrence of this misfortune calls for patient and thorough cleansing, and perhaps for the establishment of effective drainage. The line of each form of union should be carefully inspected, and points of doubtful coaptation should be fortified by additional stitches before the return of the viscera, as post-operative leakage will be promptly fatal. The exclusion of the contents of the organs from the seat of proposed union must be rigorously practiced by every practical method (page 659), for obvious reasons. The development of a post-operative peritonitis indicating infection calls for prompt exposure of the parts, to repair defects and remove deleterious agents. The tendency to kinking of the gut by operative confinement or constriction from superimposed weight or pressure should be anticipated and remedied in the first instance by supporting sutures applied at either side of the anastomosis (Kappeler) before the abdomen is closed. A sharp bend in the jejunum beyond the point of union with the stomach, its constriction at the seat of the slit in the mesocolon, and closure

of the transverse colon by the pressure of the loop of intestine carried in front of it for attachment to the stomach, are practical illustrations of these dangers. Gastric alimentation of small amount, and of a fluid and bland nature only, should be given for the first few hours, if circumstances will permit, rectal alimentation of a more substantial character being employed at the same time. That the opening of intercommunication should be sufficiently large to obviate complete closure is clearly apparent. An opening two inches in length in incision cases is regarded as ample to prevent this sequel. An impairment of the vascular supply of the viscera should be avoided by careful treatment of the mesentery to obviate the danger of gangrene of the intestines. Only the upper part of the jejunum should be utilized, remembering that the danger of death from inanition increases in proportion to the exclusion of the small intestine from the field of nutrition. The anastomosis should be made at a point as far as possible from the seat of the disease and as near the greater curvature as practicable, where the organ is thin and atrophied. The anastomotic point of the jejunum is from twelve to fifteen inches from its duodenal junction. Measures should be taken in every instance, when possible, to prevent the pancreatic and biliary fluids, as well as those of the stomach itself, from returning to the stomach by regurgitation and short-circuiting, for reasons both obvious and well understood. In other words, means must be taken to permit of prompt and complete emptying of the proximal portion of the small intestine. The intermittent, expulsive character of the movements of the pyloric end of the stomach during digestion (page 756) suggests the wisdom of making the anastomosis at this situation when practicable. The employment of valvular flap devices for the purpose is less reliable, more difficult and complicated than that of the Murphy button, the bone bobbin, and other similar agents.

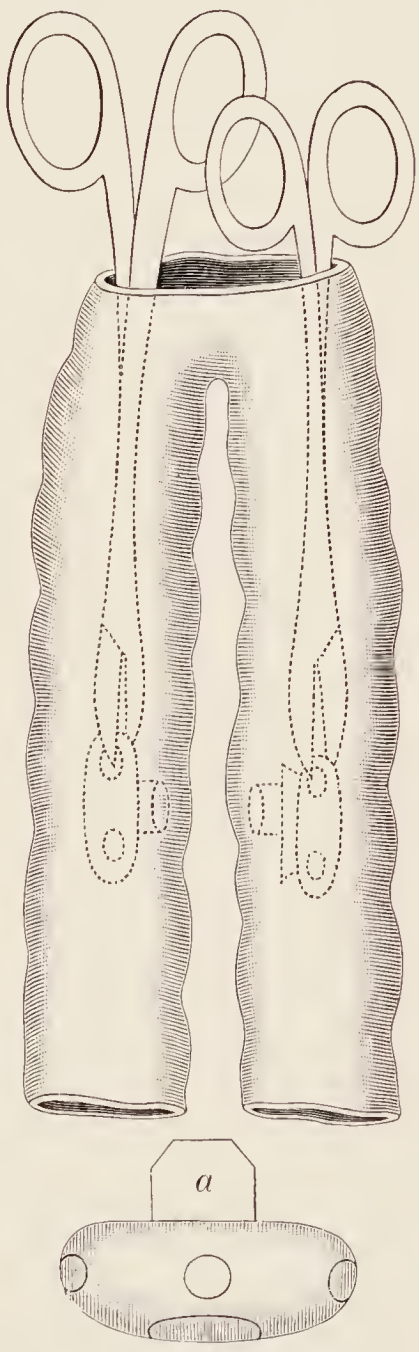



FIG. 982.—The operation of entero-anastomosis, Gallet's method, with ordinary forceps. *a*. Weir's modification of stem of Murphy's button.

*Entero-anastomosis* with the Murphy button can be quickly carried into effect—after opening the intestine for union with the stomach—by introducing through the opening, by means of ordinary forceps (Gallet) (Fig. 982), or forceps devised for the purpose (Turnure), a segment of button into each limb of the intestine in such a manner that, when closed by opposing pressure, the stems of the segments penetrate the intervening tissues and complete the anastomosis when locked.

*The Results.—Murphy* reports with the use of his button, entero-enterostomies, 550 cases; 542 reported results, with 415 recoveries, or 76.58 per cent; deaths, 23.42 per cent (written communication).

*The Remarks.*—The careful evacuation of the stomach and intestines before operation is a wise precaution, and a time-saving measure during operation, as the tendency to and danger of infection is lessened by this means. Preparatory stimulation and strengthening of the patient is advisable when the already depressed state demands it and time will permit. The continued regurgitation into the stomach of the intestinal contents is deleterious in an extreme degree, and should be combated by lavage, medication, and posture. The median abdominal incision is commonly employed in this operation. If freer exposure of the parts is desired, this incision may be supplemented by a transverse one three or four inches in length made at right angles with the former. Union by Halsted's method of sewing is more secure and promptly accomplished than by the ordinary methods (page 646), and the importance of the submucous fibrous tissue in this connection should be kept in view (Figs. 788 and 793). The Murphy button affords the quickest means of union, but is open to the comparative objection of sometimes remaining indefinitely as a foreign body in the stomach or intestine. It does not appear, however, that the retention has been followed by a troublesome sequel. A relative increase in the size of the intestinal end of the button seems likely to favor its escape into the intestine, thus lessening the frequency of its entrance to and retention in the stomach. The use of the Murphy button may prevent entirely, and certainly will for some time, the formation of a spur, but in some cases marked contraction of the anastomotic opening takes place. *Weir* bevels the end of the stem of the male part of the button (Fig. 982, *a*,) to facilitate perforation of the intestinal wall in entero-anastomosis by Gallet's method. *Carle* draws the borders of the intestinal opening around the stems of the button by means of one or two Lembert sutures, instead of by the purse-string suture commonly employed (Fig. 816).

**Jejunostomy** may be practiced when gastro-enterostomy is not possible by the method of Maydl (Fig. 924) or Albert (Fig. 1333). In each the abdominal incision is made in the median line above the umbilicus; in the former the loop of jejunum is severed between suitable restraining appliances (Fig. 868), and the proximal end is implanted into the convex surface of distal part. In the latter plan entero-anastomosis (jejuno-jejunostomy) is performed, and the apex of the intestinal loop is carried out through the median incision, thence beneath the integument through a secondary opening as in gastrostomy (Fig. 952).

*The Results.*—Gastro-enterostomy. In Wölfler's method the general rate of mortality was 38.09 per cent in 231 cases; in Von Hacker's, 35.52 per cent in 152 cases. *Carle* reports 60 cases of his own in which the Murphy button was employed without a death. His combined rate, however, was 7.4 per cent (Keen). *Czerny* operated in a series of 35 cases with Murphy's button with a mortality of 34.28 per cent, and later in a second series of 65 cases with a mortality of 22.28 per cent. *Murphy's* latest report of the use of his button: gastro-enterostomies, 575 cases; 417 reported results, with 317 recoveries, or 76.01 per cent; deaths, 24.03 per cent (written communication).

Decalcified bone plates, 61 cases with 14 deaths (Magill).

The present rate for all cases is about 30 per cent mortality; that for

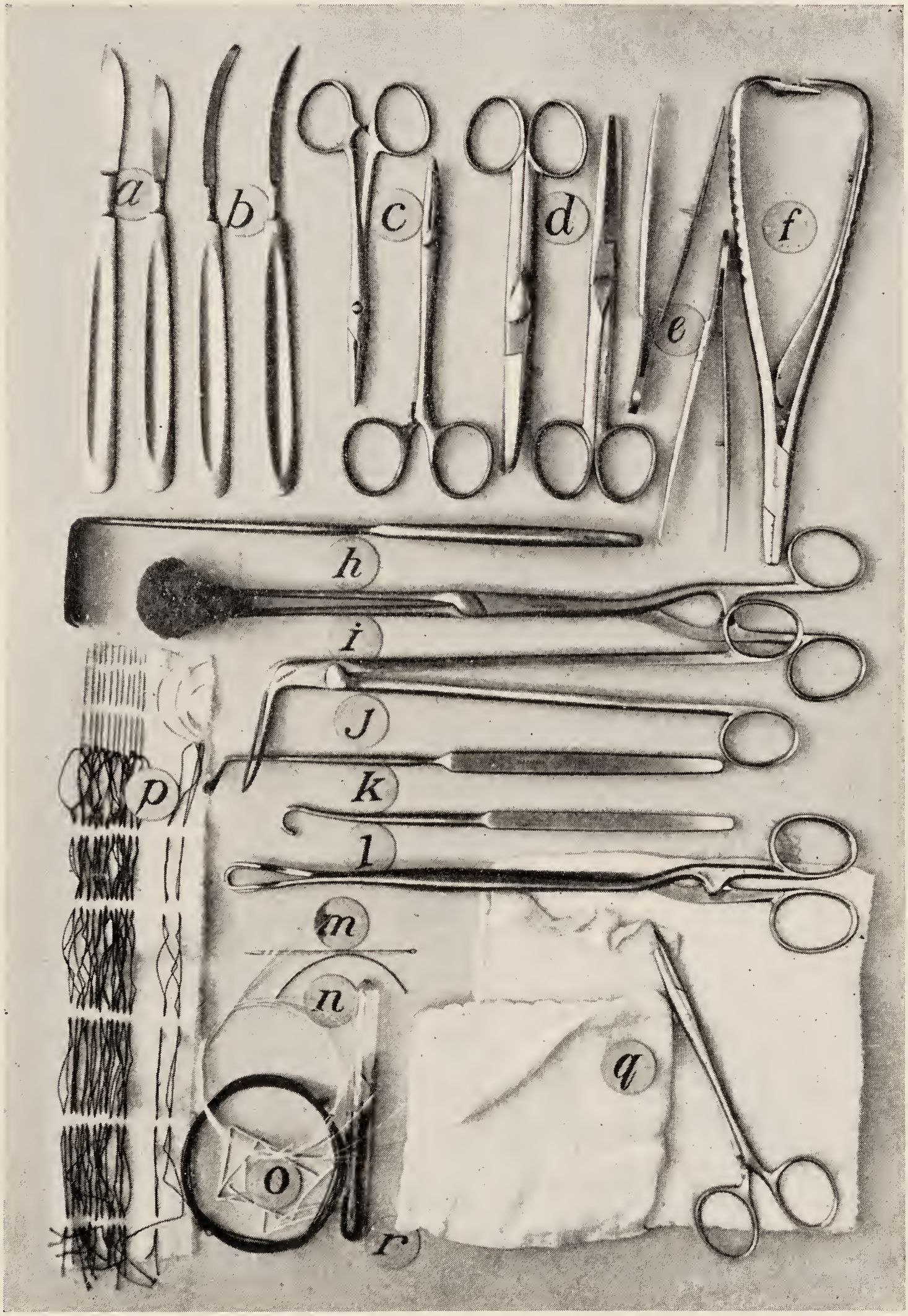



FIG. 983.—Instruments employed in operations on the stomach.

*a*. Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Curved and straight scissors. *e*. Thumb forceps. *f*. Needle-holder. *h*. Retractor. *i*. Sponge-holder. *j*. Cleveland's ligature carrier. *k*. Aneurism needle. *l*. Blunt hook. *m*. Curved and straight needles. *n*. *r*. Silkworm and catgut. *o*. Traction loops. *p*. Straight, round, and curved needles threaded with black silk. *q*. Small and large gauze pads, with tapes, the large anchored to forcipressure. Broad retractors, tenacula, and rubber dam are needed.

malignant disease, 34.5, and for non-malignant, 14.3 per cent. Union by the Murphy button appears to give 12 per cent better rate than sewing. The average longevity after operation in malignant disease is about eight months; in non-malignant, sufficient time has not yet elapsed to establish a record.

Increased experience will no doubt improve the record.

**Pylorectomy.**—The term pylorectomy is applied to the operation for removal of the pylorus and as much of the stomach and duodenum as may be involved by the disease calling for the procedure. Before beginning the operation, the attention of the surgeon should be directed carefully to the vascular supply of the pylorus and its relation to the nutrition of contiguous structures, as modified by the morbid effects of the disease (Fig. 984). The

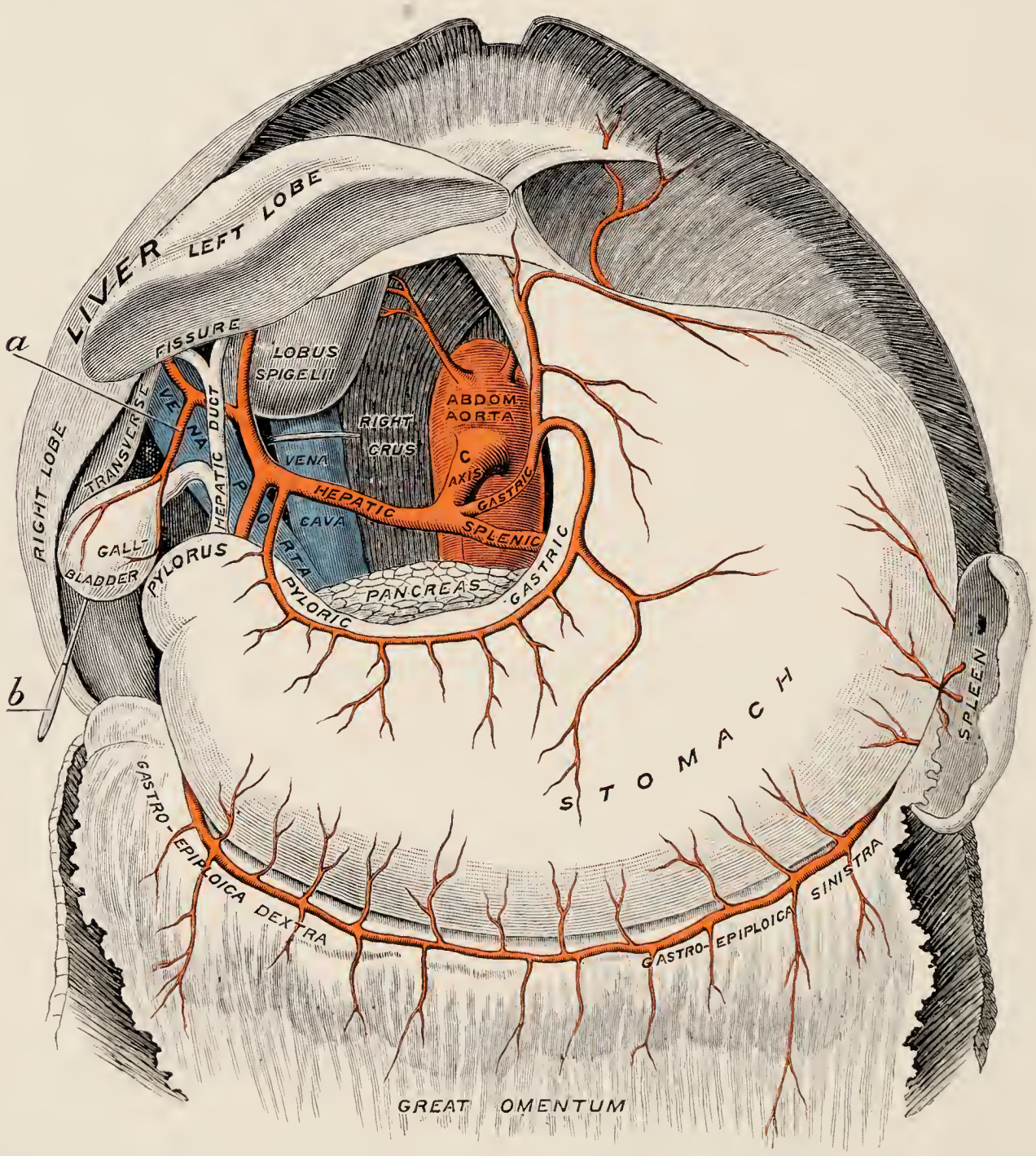



Fig. 984.—The anterior surface of the stomach, showing its relations and vascular supply. *a*. Cystic branch. *b*. Probe passing through foramen of Winslow.

probable complications incident to the procedure should be anticipated as far as possible, and the proper resources for their relief contemplated, in order that wise forethought may contribute to prompt and discreet action during the operation.

*Preparatory treatment*, characterized by frequent washing out of the stomach, regulation of the bowels, sterilized diet, and proper stimulation

should, when possible, precede for some days the more active measures. In all instances the stomach should be completely emptied, and carefully cleansed by a mild antiseptic fluid, such as a boric or salicylic-acid solution, an hour or so before operation. Both local and general aseptic measures should be carefully practiced and provided for in advance of the procedure. Means calculated to prevent and overcome shock should be at hand (page 105) for prompt utilization.

*A careful counting of the sponges, pads, and of other agents employed in this and all abdominal procedures should be made at the outset, and their introduction into the cavity definitely noted by some responsible person indicated for the purpose, in order that all may be accounted for before the abdominal wound is closed.*

*The Operation of Pylorectomy* (Kocher).—For the sake of a more lucid description, the operation can be divided into three stages of procedure: (1) exposure of the pylorus; (2) isolation of the pylorus; (3) resection of the diseased tissues. The primary incision is made in the median line.

*The Exposure of the Pylorus.*—Press upward the pylorus to the proposed site of the abdominal incision, if need be; make a vertical incision down to the peritonæum in the median line above the navel, of sufficient length to permit of digital examination of the diseased area; arrest hæmorrhage, open the peritonæum, introduce the thumb and index finger, and carefully estimate the extent of the disease and note the presence of glandular and other secondary involvements. If further procedure be advisable, introduce through the opening a broad, flat sponge or thick gauze pad to collect the blood, and extend the incision sufficiently for the purpose by means of scissors; arrest the bleeding points and make a second incision at right angles to the median, if necessary for the proper observation and manipulation of the parts.

*The Remarks.*—The incision in the median line in the making, the arrest of hæmorrhage, and in subsequent union of the borders, is the best, as any needless increase of time is to be avoided. However, the wound should be enlarged transversely to the right or left when expediency demands a more extended examination or manipulation than the median incision affords. The presence, location, and the extent of adhesions, the existence and situation of enlarged glands and involvement of the liver, gall bladder, pancreas, colon, or stomach, should be carefully determined. Adhesions between the stomach, the colon and liver, and enlarged glands near the pancreas, especially the head, at the lesser curvature of the stomach near the cardia and œsophagus, at the greater curvature, especially at the pylorus and between the stomach and colon and in the omenta, are not infrequent at one or more situations in these cases. If extensive glandular enlargement or adhesions are present, gastro-enterostomy should be done instead of pylorectomy.

*The Isolation of the Pylorus.*—Raise the diseased tissues carefully into the wound as far as practicable, and note again the extent of the morbid process; separate the greater and lesser omenta from the stomach and duodenum by means of ligatures and scissors carried as close to the structures as

is consistent with proper removal of the disease (Fig. 985); lift the isolated tumor still farther into the wound and pack around it hot, dry aseptic gauze or sponges so completely as to prevent the possibility of infection of the abdominal cavity and exposed peritonæum; clamp the duodenum close to the edge of the tumor and outside of this point (Fig. 986), and also the stomach at the cardiac side of the tumor, with one or more forceps or by other suitable means, after pushing aside the contents.

*The Remarks.*—The diseased portion should be raised well out of the abdominal cavity in order to permit of as complete extra-peritoneal operation as possible. The severance from the stomach of the greater and lesser omenta extends a little beyond the diseased area (Fig. 986, *b*, *f*), and is accomplished by double ligatures of chromicized gut, or by silk applied to

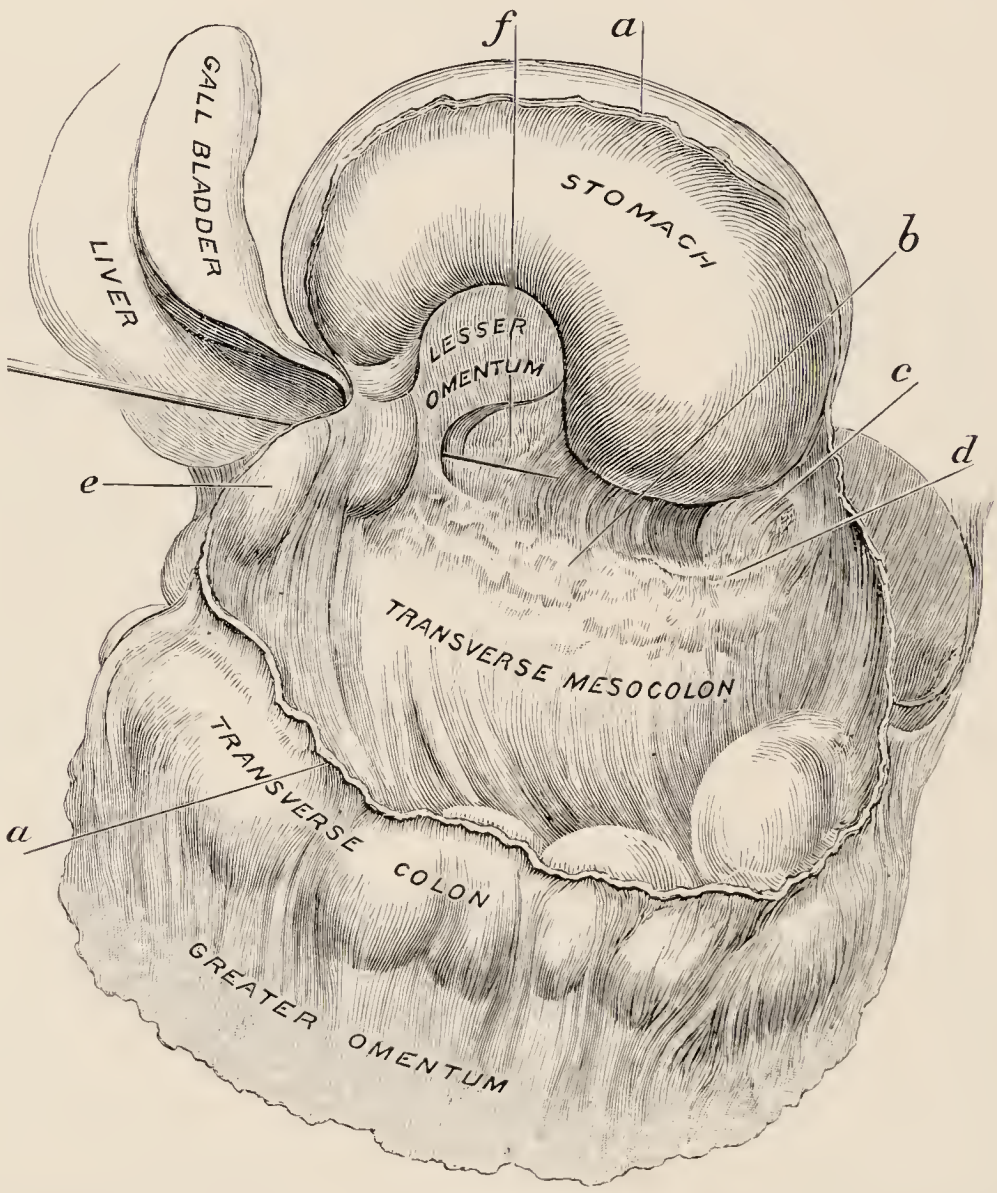



FIG. 985.—The posterior surface of the stomach. *a*, *a*. Gastro-colic omentum. *b*. Pancreas beneath transverse mesocolon. *c*. Spleen. *d*. Splenic vein. *e*. Descending duodenum. *f*. Papillary tubercle.

isolated portions of the omental tissue by means of an aneurism needle or Cleveland's ligature carrier (Fig. 983, *j*). The width of the portion grasped by the respective ligatures will be governed by the thickness of the tissue and the size and number of its vessels, remembering to include only the amount that can be securely tied. The illustration (Fig. 986) indicates approximately the number and distance between the ligatures.

*The Resection of Diseased Tissues* (Fig. 986).—Sever the duodenum with scissors and thoroughly disinfect the distal end with a strong sublimate solu-

tion; wrap the end in sterilized gauze and turn it outward with the forceps (*a*); wrap the proximal end in moistened, sterilized gauze and raise the tumor upward still farther; cause the assistant to grasp the stomach at each border beyond the line of proposed section with the thumb and index finger

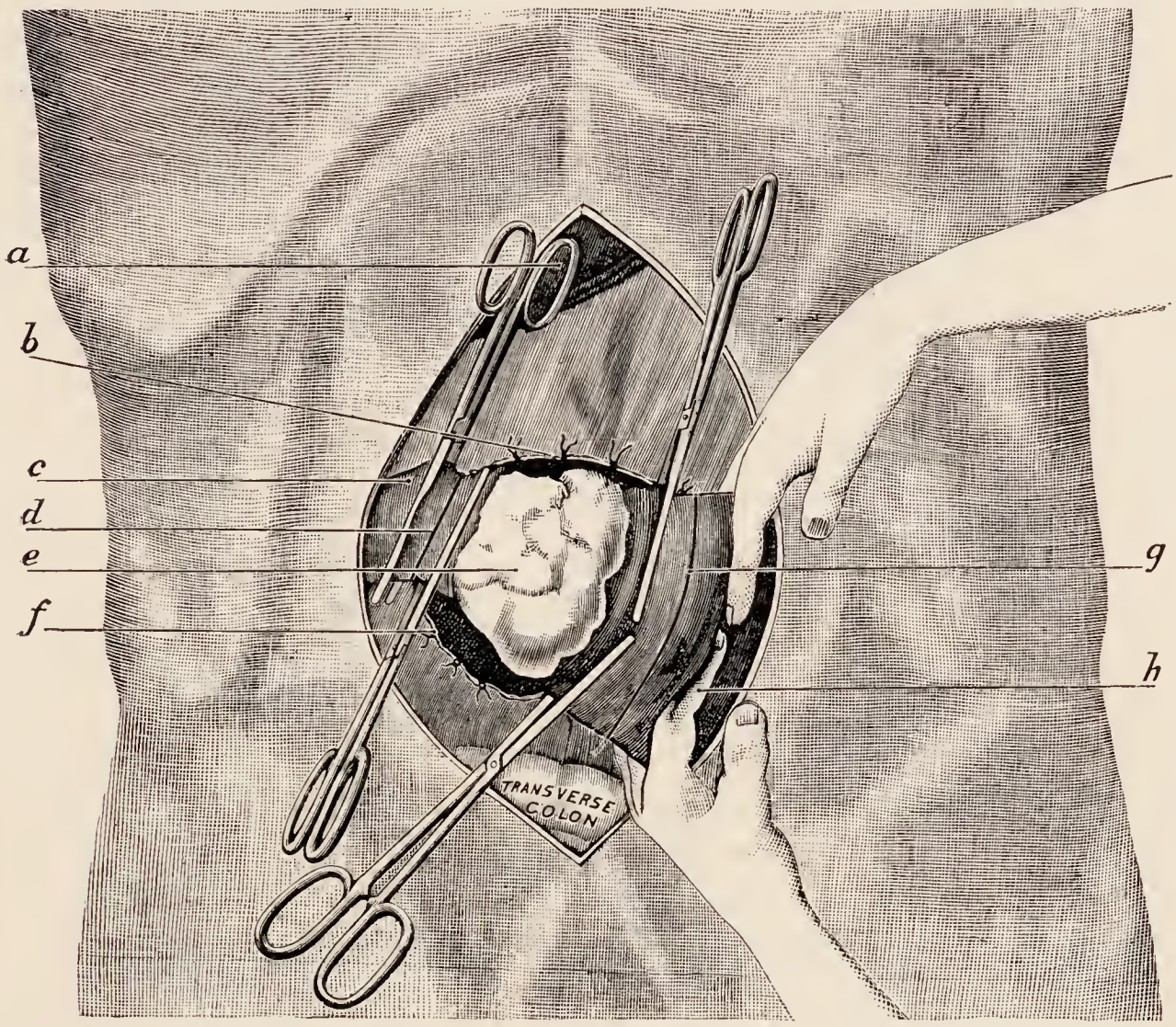



FIG. 986.—The operation of resection of the pylorus, first stage, Kocher's method. *a*. Liver. *b*. Line of severance of lesser omentum. *c*. Duodenum. *d*. Line of division of duodenum. *e*. Diseased mass. *f*. Line of severance of greater omentum. *g*. Line of division of the stomach. *h*. Fingers of assistant acting as compressing agents.

of each hand, or with the index and middle fingers of the same (Fig. 986, *h*); surround the stomach at the seat of proposed section and the hands of the assistant holding it with an abundance of sterilized gauze; with scissors divide the stomach parallel with the clamp, arresting the bleeding points with forcipressure as they appear; remove the tumor, wipe away all infecting agents that may have escaped, and ligature the important vessels. The union of the viscera may be made in two ways—i. e., directly as immediately follows, or indirectly (pylorectomy with gastro-enterostomy), as practiced by Kocher (Fig. 994), and properly the completion of the operation just described.

*The Remarks.*—The division of the walls of the stomach is modified somewhat by the outline of the disease, the aim being to follow this outline as nearly as may be consistent with expedient repair; a healthy margin of not less than half an inch should always be removed at either extremity of the disease. Both walls of the stomach should be divided along similar lines, unless too great sacrifice of healthy tissue be the result of this action.

*The lines of section* are the transverse and the oblique (Fig. 987), the latter being single or double (Fig. 988). The single oblique line begins at the greater curvature and extends upward toward the cardiac or the pyloric end of the organ, as the location of the disease may require. The double oblique line of division is applied to the upper and lower portions of the main incision, so as to establish an extremity that will properly fit the distal end of the duodenum (Fig. 989).

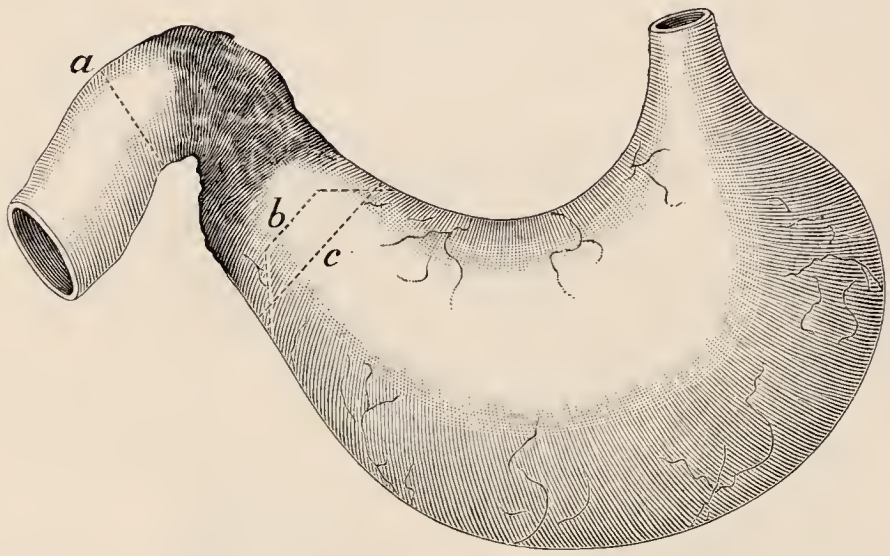



FIG. 987.—The operation of pylorectomy, showing lines of division at either limit of disease. *a*. Transverse division of duodenum. *b*, *c*. Transverse and oblique divisions of the stomach.

*The Joining of the Intestine and Stomach.*—The seat of insertion of the duodenum being determined, the remaining part of the gastric wound is promptly closed by one of two methods of sewing: 1. By means of an overhand continuous silk suture, carried up to the point of duodenal implantation, followed by inversion of this line of sewing by continuous or interrupted Lembert or Halsted suturing carried so as to include the submucous fibrous coat. 2. By union of the mucous coats with a continuous suture, supplemented by a double row of Lembert sutures carried through the sero-muscular coats, or the second row, need include only the serous coats. The former plan is employed by Kocher, only continuous sutures being used (Figs. 871 and 872). This plan is certainly the most expeditious, and is equally secure. In the instance of transverse division of the stomach the duodenum is implanted at the upper or lower portion of the wound as best meets the requirements of the case (Figs. 990 and 991). If the stomach be much dilated, the duodenum should be joined close to the greater curvature (Wölfler) (Figs. 789 and 790).

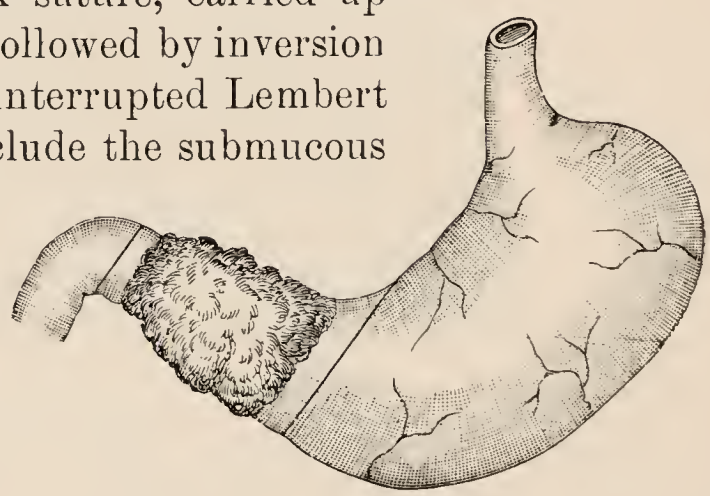


FIG. 988.—Pylorectomy for carcinoma of the pylorus.

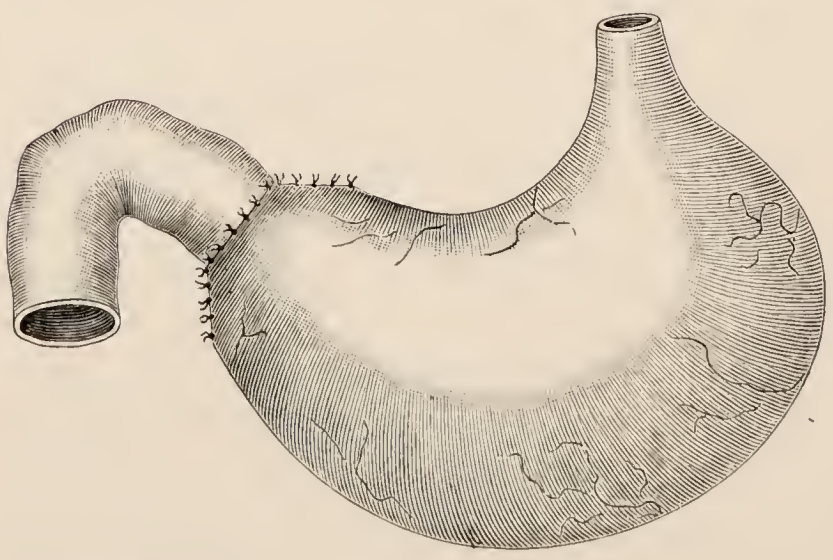


FIG. 989.—The operation of pylorectomy. Duodenum implanted at center of pyloric division.

*The Remarks.*—The cavity of the stomach should be mopped dry, and sponges with strong attachments introduced for support and cleanliness,

being removed as the closure progresses. Curved needles for sewing the inner, and straight for union of the outer surfaces, are the best. The avoidance of folds or puckering of the line of union is essential to its security. The suturing together of the divided borders is facilitated by partial section and sewing instead of complete division before suturing, for thus better command of the parts is secured and more rapid and effective work performed; also, leaving some of the sutures long for clamping and support assists materially in the union of the parts. The joining of the parts by simple sewing is a longer though more substantial method of procedure than by means of mechanical expedients. Therefore, the condition of the patient and the experience of the operator count for much in the selection of the best means of union in individual cases. Absorbable tubes and bobbins and Murphy's button are the mechanical expedients which are regarded as serviceable substitutes for sewing, on special occasions. *Greig Smith* regarded the absorbable tube as the best agent of union in those cases in which the disease is of a limited extent and involves the duodenum rather than the stomach, and in which the divided borders of the viscera can be approximated without undue traction. A curved decalcified bone tube (Fig. 992) with a broader gastric and a narrower intestinal end, provided with an intervening transverse groove with perforations, is fastened and held in place by purse-string suturing at both openings, followed by union of the free borders by a continuous suture. This appliance must be adjusted with care, and the mucous borders inturned and hidden by carefully placed sero-muscular sutures.

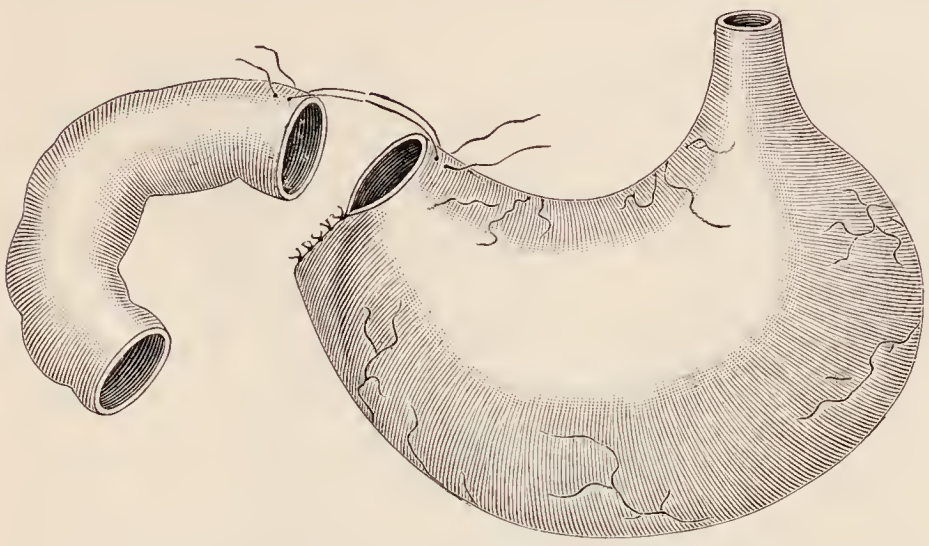


FIG. 990.—The operation of pylorectomy. Duodenum implanted at line of lesser curvature.

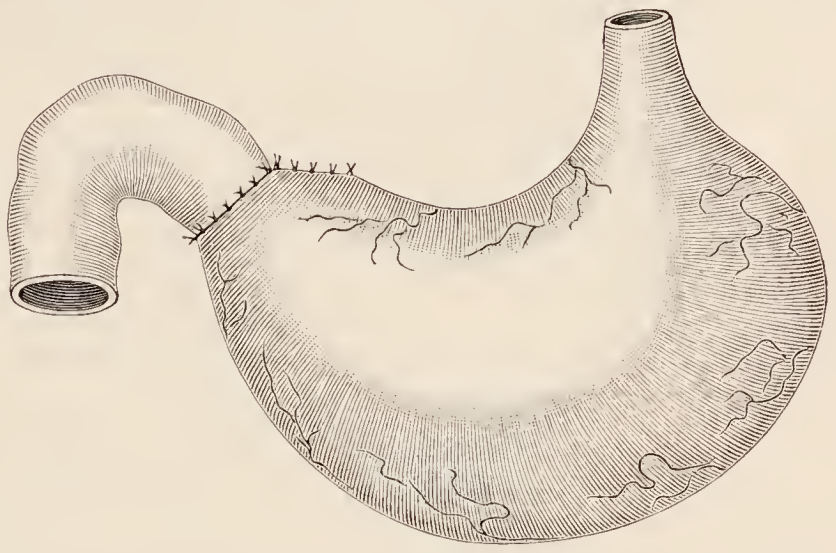


FIG. 991.—The operation of pylorectomy. Duodenum implanted at line of greater curvature.

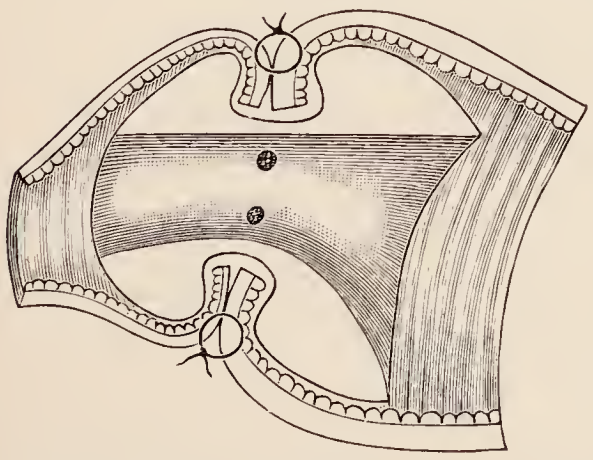


FIG. 992.—The operation of pylorectomy. Apposition of duodenum with stomach by sutures over decalcified bone tube.

**Pylorectomy combined with Gastro-enterostomy.**—This combination of methods is employed especially when divided borders can not be united with

each other in the stereotyped way after the removal of the morbid growth. *Kocher* regards it as superior in many respects to the older plan even in

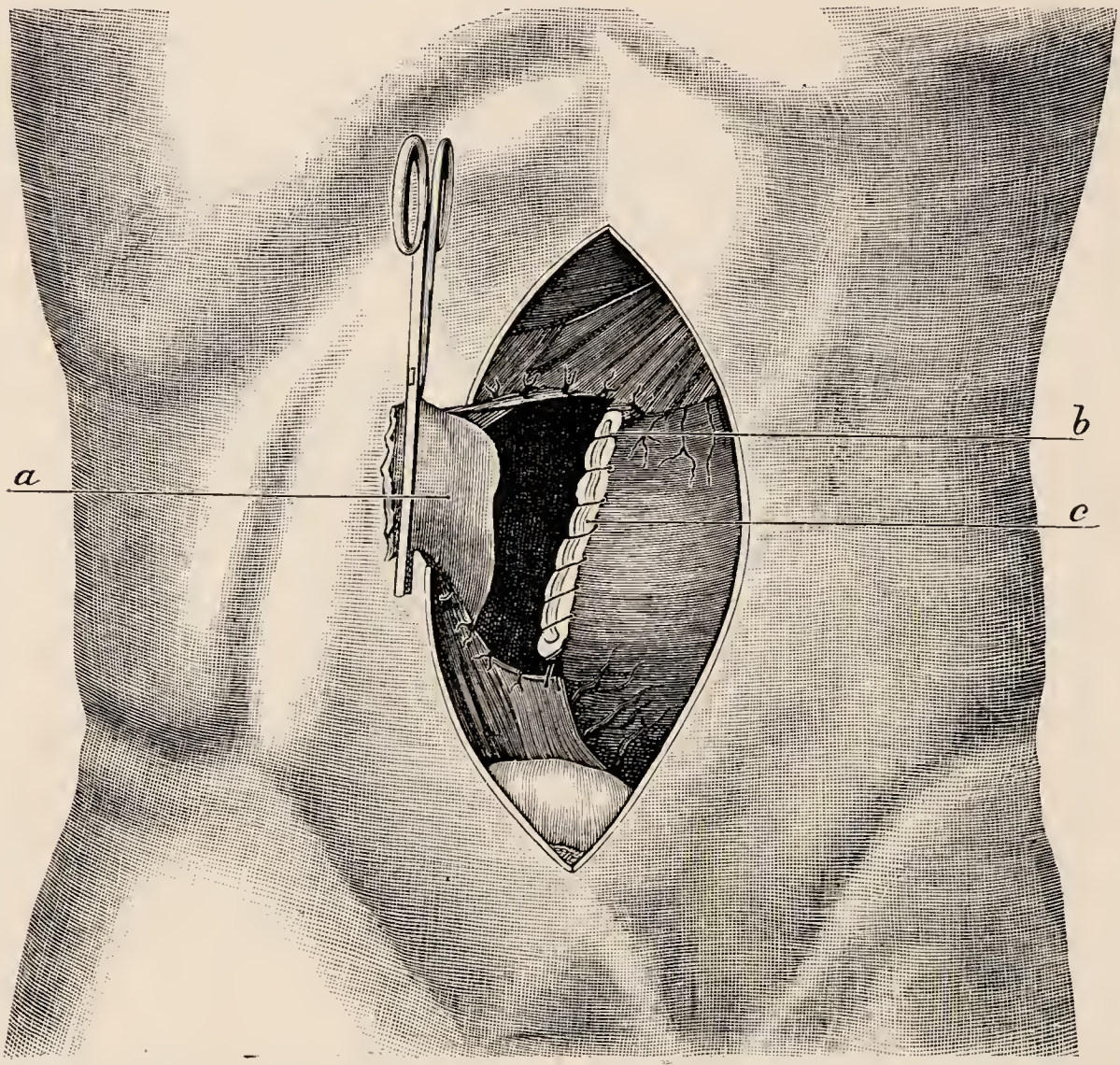



FIG. 993.—The operation of resection of the pylorus and gastro-enterostomy, Kocher's method. *a*. Duodenum. *b*. Border of stomach sutured by a continuous suture penetrating all of the coats. *c*. United borders of the mucous membrane of the stomach.

cases suited to the latter, and practices it almost exclusively. *Czerny* favors reversal of this order of procedure by the doing first of posterior gastro-enterostomy, followed by resection of the growth and closure of the stomach and duodenum. *Kocher* closes the wound in the stomach entirely by an overhand continuous silk suture carried from the greater to the lesser curvature of the stomach through all the coats (Fig. 993). Then, after cleansing the united borders, the primary row is invaginated and covered in by a second row of continuous Lembert sutures carried through the sero-muscular walls only. After all infecting agents are removed and the parts thoroughly cleansed, and the assistant has grasped the stomach with both hands and pressed it to the right (patient's) so as to close the duodenum (Fig. 994), liberate and cleanse the duodenal end, close the duodenum with forceps and apply the end to the stomach so as to permit of a ready union to each other of the posterior walls of the viscera, by means of a long continuous silk suture (*b*) the ends of which remain free; make an incision into the stomach (*e*) one fourth of an inch above the line of sewing corresponding in length to the width of the duodenum; arrest hæmorrhage, and unite the borders of the respective organs with each other on the side already attached by a continuous suture carried through the walls, or by a continuous one

carried through the mucous membranes only, and on the opposite side by a sero-muscular continuous suture; arm the long, free extremities of the primary posterior suture with needles, and therewith supplement the anterior line of sewing with a final continuous row, including the serous coats only; thoroughly cleanse the parts, especially the line of suture; remove the protecting gauze, replace the organs, and close the abdominal wound.

The union can be accomplished more quickly by Maunsell's method (Fig. 808), or by the absorbable tube, or the Murphy button. Both duodenal and gastric openings can be closed and the union made at the posterior surface either by, 1, direct sewing; 2, Murphy's button; 3, absorbable plates, tubes and bobbins. If the space between the viscera be too great for their proper apposition, the jejunum can be joined with the stomach in the manner already described (gastro-enterostomy). The method of procedure employed should be selected with due regard for the beneficent influence of

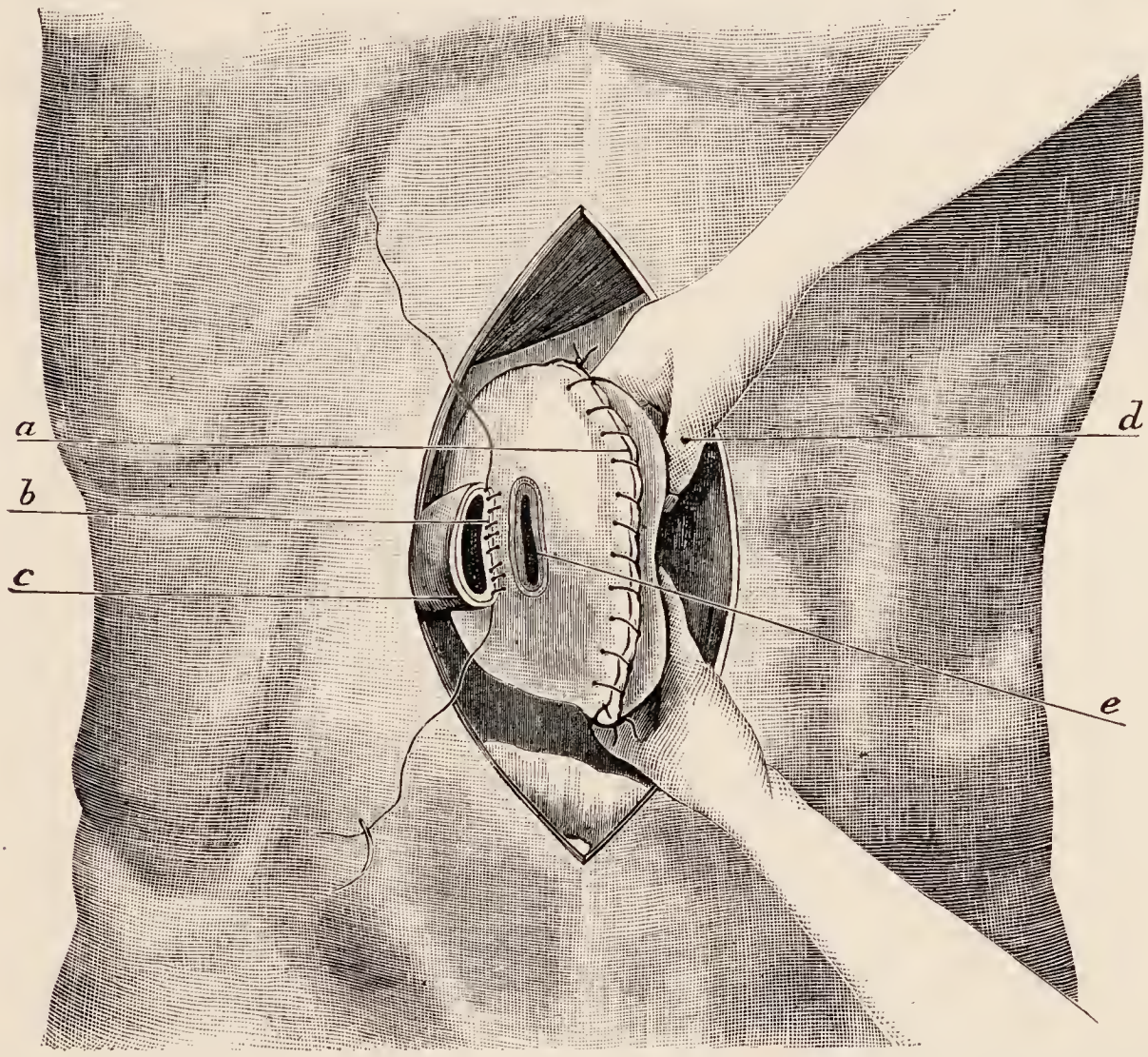



FIG. 994.—The operation of pylorectomy and gastro-enterostomy, Kocher's method. *a.* Continuous serous suture closing the stomach. *b.* Post-serous suture between stomach and duodenum. *c.* Duodenum. *d.* Assistant closing stomach and duodenum by pressure. *e.* Opening in posterior wall of stomach.

promptness of execution and of experience on the immediate and future outcome of the case.

*The Precautions.*—Digital, instrumental, sponge and textile fabric temporary closure of the openings of the divided viscera are each advised and practiced with care, to prevent peritoneal infection. The retention of a sponge or of gauze in the stomach after final closure of the wound should be avoided (page 769). The underlying vessels must be carefully guarded

during separation of the tumor, and the connecting tissues separated and tied singly or doubly as suits the circumstances of the case. The transverse mesocolon should be respected, as injury of it may result in impaired circulation and gangrene of the colon. And, too, gangrene of the colon may follow division of the omentum at the greater curvature of the stomach (Fig. 985, *a*, *a*). Deep and abundant gauze or sponge packing is imperatively demanded to prevent peritoneal infection. Small strips of iodoform gauze carried around the line of suture and allowed to escape at the external wound, and remaining for two or three days until danger of leakage has passed, are advised by cautious and experienced surgeons (Fig. 918). The introduction into the abdomen of sublimate or similar solutions should rarely be practiced, as the use of absorbent gauze packing and hot saline solutions are equally serviceable and much less dangerous.

The length of time required in many operations on the abdominal contents, together with the frequent great debility of the patient, bespeaks a wise selection and the cautious use of anæsthetics. Chloroform is less often followed by vomiting than is ether. Nitrous oxide in abdominal operations requiring extended and careful technique is highly objectionable because of the frequent inability to control the spasmodic movements attendant on its use. However, the primary administration of nitrous oxide in any operation for the amelioration or relief from some of the objectionable effects of ether is a matter of quite common practice in large towns and in hospitals, and offers patients an escape from the primary irritation and some of the annoying after-effects of this anæsthetic. A more extended employment of local anæsthesia from weak solutions of cocain, eucain, holocain, etc. (page 31), is to be encouraged. In fact, much of the work on the human viscera can be carried on without anæsthesia with but little annoyance to the patient. The administration of morphin hypodermically during the latter part of an operation under ether anæsthesia permits the practice of much of the minor and final steps of an operation without further use of ether, thus shortening considerably the period of ether administration (page 24). The free utilization of the hot saline solution in the prevention and treatment of shock by injection into the cellular tissue of the breast, thigh, etc., and into the veins in urgent cases, is of significant importance in abdominal operations.

*The Remarks.*—Pylorectomy for malignant disease is contraindicated when contiguous tissues are involved and secondary deposits are present, especially when attended with restricting adhesions. Infected glands and other limited involvements should be removed when practicable. The ability to outline the tumor *before* laparotomy is strongly suggestive of an unfavorable outlook; the reverse can be regarded with favor. Therefore, the scope of preparation for operation should comprehend the accepted methods of surgical relief for the conditions as they may appear on exposure. Thorough cleansing of the stomach and rectal stimulation are the essential elements of routine practice. Rectal alimentation alone should be practiced for the first two or three days after the operation, if the patient's condition will permit. In the instance of the use of the Murphy button, gastric feeding may begin at an earlier date. The incisions into the viscera should correspond with

each other in direction and extent as nearly as practicable, to facilitate prompt union and avoid distortion. Distorted implantation and joining of the duodenum with the stomach and irregular union of divided borders should be sedulously avoided; all should be joined in their natural outline with great care. The raising and removal of a V-shaped flap from the stomach composed of the sero-muscular coats only, for the purpose of narrowing the gastric opening, followed by suturing of the divided tissues with each other, with inversion of the undivided mucous coat, is recommended as a safer and prompter plan of action than a complete division for the purpose (Billroth). In circular union the internal employment of sutures is better than the external, and should be practiced as far as is possible, the remaining portion being closed and the entire line fortified by one or two rows of external sutures. About one third of the line of implantation can be united by the internal sewing (Fig. 789) (Wölfler). Twenty-five or thirty round, straight cambric needles, each armed with Chinese silk, should be prepared before commencement of the operation (Fig. 983, *p*). Delay in procedure for the purpose of threading needles is an inexcusable sacrifice of time and human vitality. *Kocher* regards a continuous suture carried entirely through the borders of the wound as the best primary suture for security, control of bleeding, and expeditious work; and, further, that the use of clamps adds to the safety, facility, and dispatch in operation, and believes that no danger comes to the tissues from their use when they are applied only with needed firmness. *Jessett* advised the ligature of the main arteries of the greater and lesser curvatures of the stomach (Fig. 984) just outside of the limits of the disease, thus so controlling the circulation of the omenta as to permit the ligature of large segments of the greater and tearing through of the lesser omentum, hastening thereby resection. *Kocher*, his combined method, 23 cases, 2 deaths. *Lücke*, 7 consecutive recoveries.

*The Results.*—Shock and perforative peritonitis are the most frequent causes of death associated with the operation. In pylorectomy, when performed for non-malignant disease, 8 per cent died from the operation; for malignant disease, 25 to 53 per cent, according to different estimates. In 59 cases of recovery the average length of life was eleven months and four days (Richardson). Of 130 cases done prior to 1892, the rate of mortality, as based on the extent of the adhesions, varied as follows: No adhesions, 50 per cent; slight adhesions, 60 per cent; and numerous adhesions, 97 per cent (Schramm). According to later estimates, with no adhesions the rate of mortality was 27.2, and with extensive adhesions 72.7 per cent (Wölfler). Even better results than these are stated in rare instances in the experience of renowned operators. *Mikulicz*, 10 cases, 1 death. *Krönlein*, 29, with 2 deaths.

**Pyloroplasty** (Heineke-Mikulicz).—The term pyloroplasty is applied to the operation for the relief of stenosis of the pyloric orifice of the stomach resulting from non-malignant, morbid changes. Preparatory washing out of the stomach need not be practiced, if to do so will cause much distress to the patient, as the contents of the stomach can be made to gravitate to the cardiac end by attention to the position of the patient. In other respects the preparatory and precautionary measures of stimulation and asepsis, which

are addressed to abdominal operations for debilitating disease, should be carefully practiced.

*The Operation.*—Make an incision in the median line between the sternum and navel two to four inches in length; draw apart the borders of the wound with traction sutures; raise the pylorus into the wound with the thumb and fingers, separating or stretching by gentle traction any opposing adhesions; isolate the pylorus from contiguous structures by abundant sponge or gauze packing so completely as to prevent the possibility of peritoneal infection from escaping fluids; make a longitudinal incision through the anterior wall of the stomach, midway between the upper and lower borders, close to the pylorus, sufficiently large to admit the index finger; pass the finger through the opening into the pylorus to ascertain the presence and degree of the obstruction; remove the finger and extend the incision outward directly through the diseased parts into the healthy duodenum (Fig. 995); draw apart the borders of the wound with traction sutures carried through the entire thickness of the walls at the middle of either side of the wound, thus changing the outline of the wound from a longitudinal to a transverse direction; introduce the stitches as indicated in the cuts (Figs. 996 and 997), and, if practicable, omit the tying until all are in place; add to the interrupted row of sutures a supplementing continuous one directed to the serous coat only; cleanse and return the parts to the normal site; remove the packing and close the abdominal wound in the usual manner, if desirable.

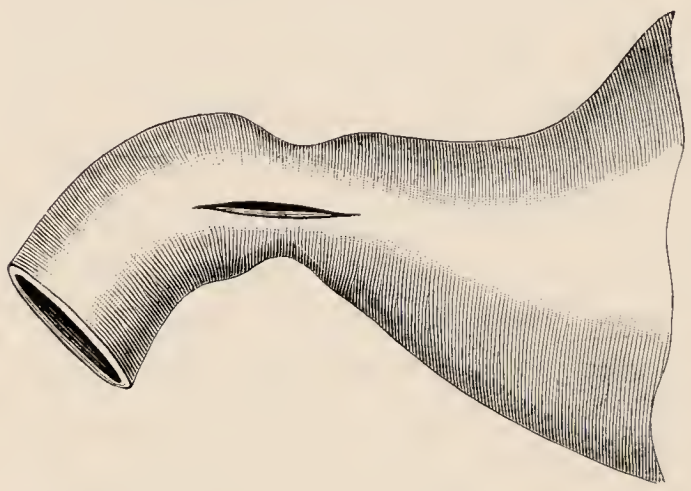


FIG. 995.—The operation of pyloroplasty, the Heineke-Mikulicz method, showing longitudinal incision of structure.

*The Remarks.*—The length of the entire incision is about two inches. The tissues of the borders of the incision may be so rigid as to require quite vigorous manipulation to change the direction of the wound and properly appose the borders. Splitting the borders of the hypertrophied tissues along the line of incision so as to form a musculo-mucous flap within and a sero-

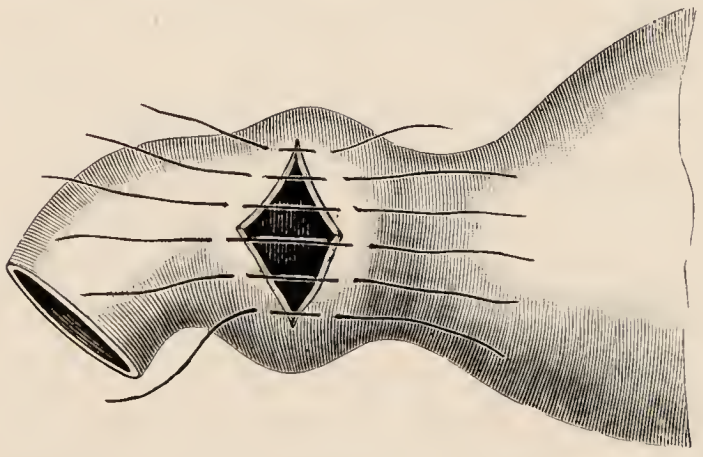


FIG. 996.—The operation of pyloroplasty, the Heineke-Mikulicz method, showing sutures placed for transverse approximation of the longitudinal incision.

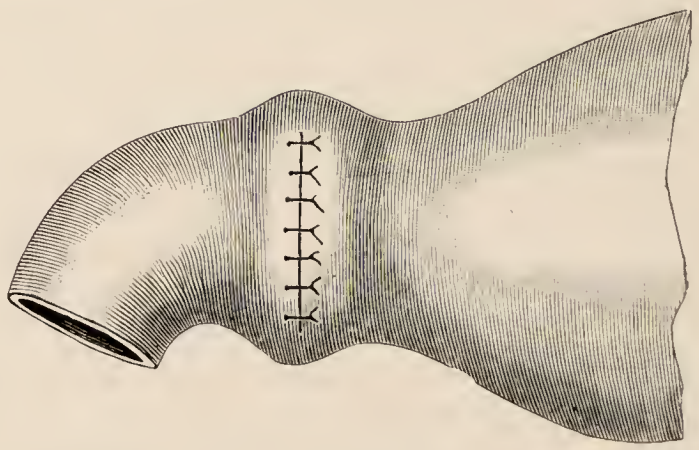


FIG. 997.—The operation of pyloroplasty, the Heineke-Mikulicz method, clearly showing union of borders and increased capacity of duodenum.

muscular one without, and uniting the inner ones together with continuous catgut and the outer with continuous or interrupted silk sutures, is advised by *Greig Smith* in cases with densely thickened borders. If the structure be exceedingly dense and unmanageable, the incision through it may be made of a diamond shape followed by removal of the included part. This course makes the transverse coaptation easier, as can be readily seen. *Greig Smith* regards the use of the absorbable tube in the lumen of much weight in the cases complicated with rigid walls of limited extent, and advises that the mucous and the remaining coats be sewed by a continuous suture independently of each other. He regards this appliance as important, because it furnishes an opening from the outset and prevents constriction during healing. Oozing only should be controlled by sewing; other forms of bleeding by ligature. If infection of the wound has taken place and doubtful cleansing be suspected, complete closure of the abdomen should be suspended and iodoform-gauze tents inserted for two or three days, after which they are removed and the abdomen closed.

*The Results.*—The general rate of mortality of the operation is about 21 per cent. Better results than this (7 per cent, Carle) are reported at a late date. The final outcome, though not entirely satisfactory, is much superior to that of divulsion of the stenosis. Formerly the simplicity of the operation and its comparatively low rate of mortality commended highly the practice, but the later development of gastro-enterostomy supplemented by the Murphy button, and the fickleness of the relief of the former, have lessened its favor with most surgeons.

**Divulsion of the Pylorus** (Loreta).—*Loreta's* operation is applicable to non-malignant stenosis only, and can be accomplished by digital or instrumental force.

*The Operation.*—The operation is similar in all essential points to that of pyloroplasty until after the stomach is incised longitudinally or vertically inside the seat of the stricture. Then introduce the index and middle fingers of the right hand into the stomach; push slowly and with care through the stricture the end of the middle finger, steadying the pylorus with the thumb and finger of the left hand applied without; raise upward the pylorus with the middle finger and insinuate cautiously the index finger by the side of the middle, carefully observing if dangerous tension be made on the outer coats of the gut; introduce the ring finger carefully by the side of the two already inserted, if the act be consistent with the maintenance of the integrity of the wall of the viscus; withdraw the fingers from the strictured part in the order introduced, and, after a brief period, reinsert in like manner as before, noting if undue resiliency of the stretched tissues be present. If the caliber remain dilated to a proper degree, withdraw the fingers from the stomach. If undue resiliency cause objectionable closure, further stretching is made by a reintroduction and separation of the fingers before the final withdrawal. On withdrawal of the fingers, observe through the opening if active bleeding of ruptured tissues be present. If so, introduce into the dilated channel the index finger, while covered with aseptic gauze saturated with a hot saline solution, and hold it there for a time

while firm circular compression is made upon it from without. After the arrest of bleeding, close the opening into the stomach by sewing in the manner usual in sero-muscular strictures. Remove the packing, cleanse the parts, and close the abdomen carefully, unless fear of infection sanctions the temporary use of gauze tents. The final dressing is then applied, and the patient nourished by the bowel for the first three or four days, after which light fluid food in small amounts is given by the mouth; solid food is not taken before the tenth or twelfth day. Instrumental dilatation offers no advantages over the digital, unless the stricture be too small to admit the end of the finger. In such cases the use of instruments should precede that of the fingers and cease when the finger is safely available for the purpose.

*The Remarks.*—The normal pyloric orifice will admit quite readily the extremity of an ordinary sized index finger. The pylorus may be bound down more or less immovably by adhesions and somewhat obscured by diseased structural changes. The gastric incision is made vertically or longitudinally; the former is thought to be attended with less hæmorrhage and is made by cutting with scissors a longitudinal fold, raised with the thumb and fingers. Complete isolation of the pylorus from the peritoneal cavity by gauze or sponges should precede the opening of the stomach.

*The Precautions.*—The usual precautions against infection from the escape of gastric fluids must be practiced. Force should be cautiously employed and the pyloric structure carefully observed to detect the presence of ruptures which may not be lightly treated. All hæmorrhage should be arrested and lacerations repaired by sewing before final closure of the abdominal wound. Cautious dilatation is necessary, as in some instances unsuspected tissue changes may permit extensive rupture as the end of the finger is being forced into the strictures. If the stomach be greatly dilated, the location of the pyloric opening may be difficult and perhaps impossible. In this instance pyloroplasty or, preferably, gastro-enterostomy should be practiced at once, if the patient's condition will permit; if not, gastrostomy, with subsequent gastro-enterostomy should be considered. The attempt to force the end of the finger through a too small constriction should give way to the primary use of a small catheter or bougie, for obvious reasons.

*The Results.*—Hæmorrhage, rupture, and shock are common causes of death from the operation. Return of the stricture is always to be feared, the same as in urethral stricture when treated on similar principles. Obstructive symptoms have returned in rare instances within a week after the operation. The general rate of mortality appears to be from 33.3 (Kinnicutt and Bull) to 40 per cent (Barton), which seems much too high for the apparent magnitude of the operation. At all events, the high death rate and the uncertainty of cure do not inspire unbiased judgment in its favor, especially when pyloroplasty, and, better still, gastro-enterostomy, are alternatives.

**Dilatation of the Cardiac Orifice.**—Dilatation of this opening has been practiced not infrequently with success for the relief from stricture there and also at the lower part of the œsophagus. The description of the technique will be found under the treatment of œsophageal stricture (page 600 *et seq.*).

**Gastro-gastrostomy** (*Gastro-anastomosis*).—Gastro-gastrostomy is practiced for relief from the infliction of hour-glass contraction of the stomach. *Wölfler*, through an incision in the median line and with aseptic precautions, exposed the deformed stomach, and made an opening of ample size to afford ready transmission of the contents of the organ into each of the pouches, corresponding as nearly as practicable to the greater curvature (Fig. 998). He united together the corresponding borders of the openings by means of his characteristic method of sewing (page 622, Fig. 999) similar viscera, and thus relieved the patient from the effects of the infirmity.



FIG. 998.—The operation of gastro-gastrostomy, Wölfler's method, showing the corresponding openings.

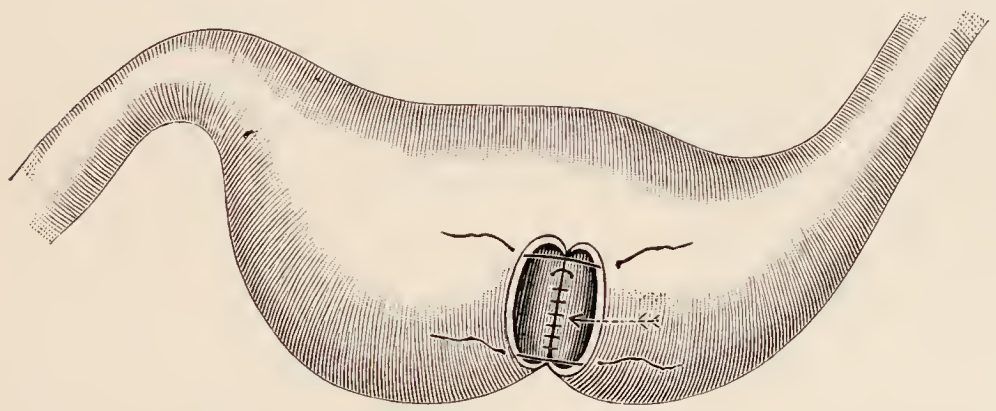


FIG. 999.—The operation of gastro-gastrostomy, Wölfler's method, showing suturing of the borders of the openings.

*The Results.*—Apparently six instances of this method of practice are noted, all but one of which recovered from the operation, and remained well some months subsequently.

*Watson*, at a more recent date and in a more decided case of contraction (Fig. 1000), practiced the following plan: The two pouches were folded upon each other, and the corresponding borders of a limited area of the apposed surfaces were sutured together (Fig. 1001), the sutures at each end of union remaining long to indicate the lines of sewing (*f*, *f*, *f*). The anterior wall of the anterior pouch was then incised longitudinally (*g*, *g*) at a point opposite to the previously united surfaces, thus affording opportunity for division of the contiguous walls of the apposed pouches at a point within the circumscribed area of sewing. The anterior incision was then closed, the remaining extremities of the long sutures were cut off short, and the borders of the abdominal wound united in the usual manner. The result in this instance was satisfactory in all respects. Watson's abdominal incision is unlike Wölfler's.

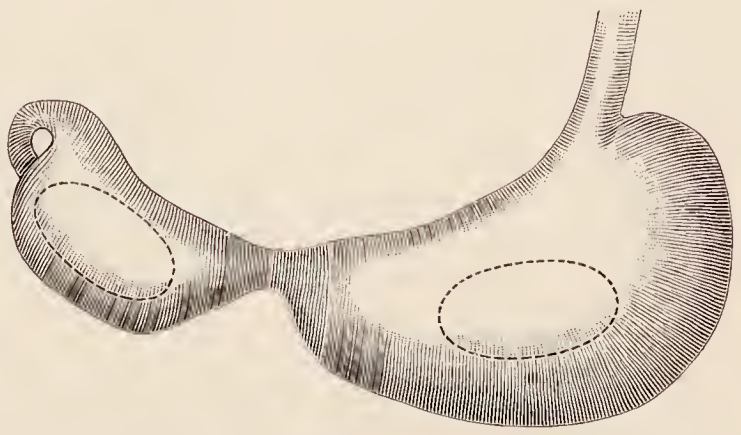


FIG. 1000.—The operation of gastro-gastrostomy, Watson's method, showing dotted outlines of anastomoted openings.

*The Remarks.*—If pyloric obstruction is present in these cases, gastro-enterostomy is indicated, and preferably at the cardiac pouch. *Weir* regards double gastro-enterostomy as preferable to gastro-gastrostomy in these cases. In the instance of adhesions preventing the apposition characteristic of the latter method, the former should be practiced. About 17 per cent die from the operation.

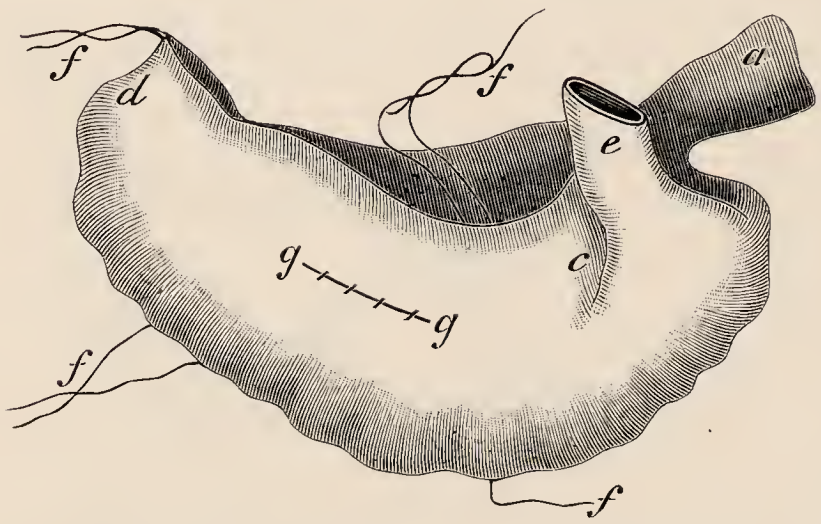



FIG. 1001.—The operation of gastro-gastrostomy, Watson's method. *a*. Œsophagus. *c*. Cardiac end of stomach. *e*. Pylorus. *d*. Constricted portion. *f, f, f*. Ends of long sutures. *g, g*. Sutured incision through anterior wall.

**Gastroplasty.**—In gastroplasty the principles and methods of action utilized to overcome the constricted portion of the stomach are identical with those employed at the pylorus for a similar purpose. Consequently the needs for the practice of gastroplasty are fittingly expressed in the consideration of pyloroplasty (page 777). *Watson* reports 17 cases with 3 deaths.

**Gastroplication.**—The operation of gastroplication, also called gastrorrhaphy, consists in diminishing the size of a permanently dilated stomach by doubling in a portion of the wall and suturing together the apposing surfaces.

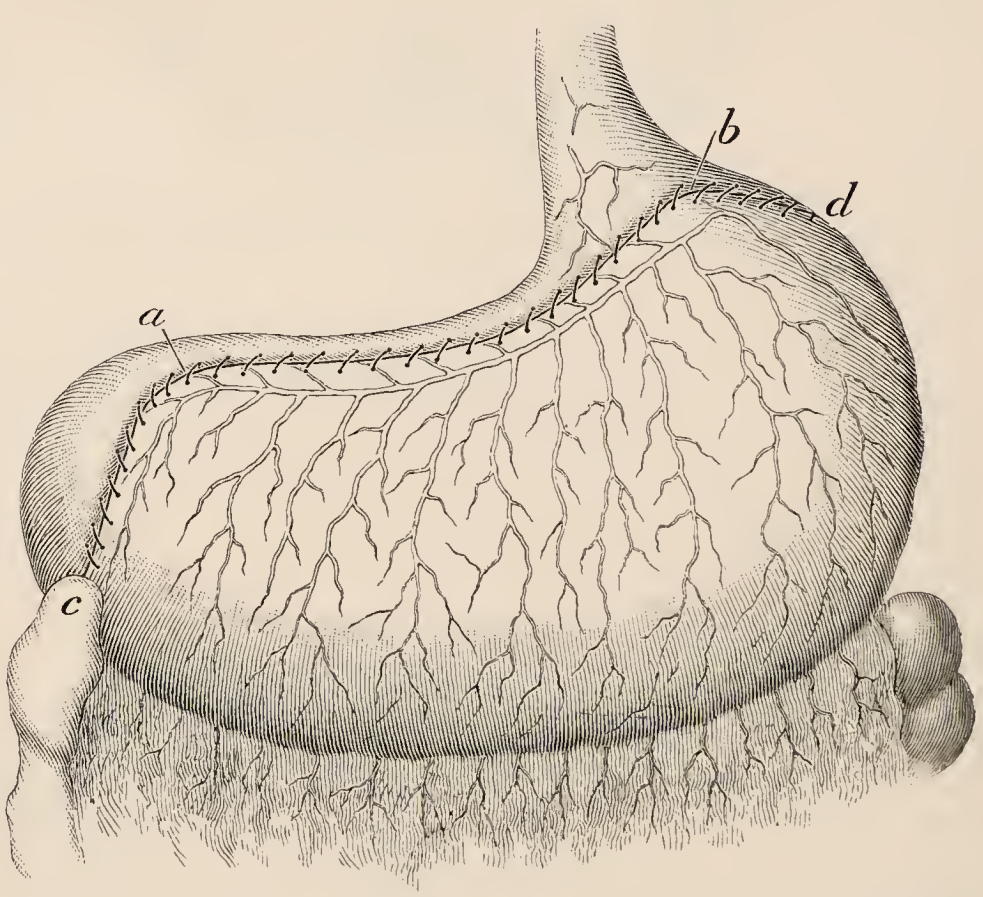



FIG. 1002.—The operation of gastroplication, Bircher's method. *a, d*. Line of union. *b*. Œsophagus. *c*. Duodenum.

*Bircher*, after carefully emptying and washing out the stomach, made an oblique incision over the cardiac portion of the organ, six inches in length, parallel with and about an inch and a half to the right of the cartilages of the ribs. Through this incision the peritonæum was exposed and opened with strict aseptic precautions. The edges of the wound were drawn asunder, the stomach was caught, raised well up into the wound, the anterior surface depressed by means of a long forceps, the greater curvature seized, carried upward over the forceps, and stitched to the lesser curvature by thirty-five silk sutures (Fig. 1002) so passed as to include only the serous and muscular coats. The stomach was returned and the abdominal wound closed at once. The

patient was nourished by the bowel for six days, was up on the twelfth, and made an uneventful recovery (Fig. 1003).

*Weir*, without knowledge of Bircher's achievement, practiced gastroplication on a patient on whom, twenty-seven months before, a successful anterior gastro-enterostomy had been done by himself for relief of pyloric stenosis. Weir opened the abdomen in the line of the old cicatrix for five inches, drew apart the borders of the opening, seized the stomach and pulled it up out of the wound as far as practicable, grasped the greater curvature and broke up the adhesions that prevented its proper upturning. Midway between the greater and lesser curvatures pressure was made on the anterior surface, in the long axis of the organ, with a sound sufficient to cause at either side longitudinal ridges of the stomach wall, which were united together over the sound for six or eight inches with interrupted silk sutures, including the sero-muscular coats. Additional rows of sutures were applied successively, each in a similar manner to the first, thereby forming a double fold of the stomach equal in width to that of the hand. The after-treatment of this patient was not dissimilar from that of Bircher's, and, like his, made a prompt recovery.

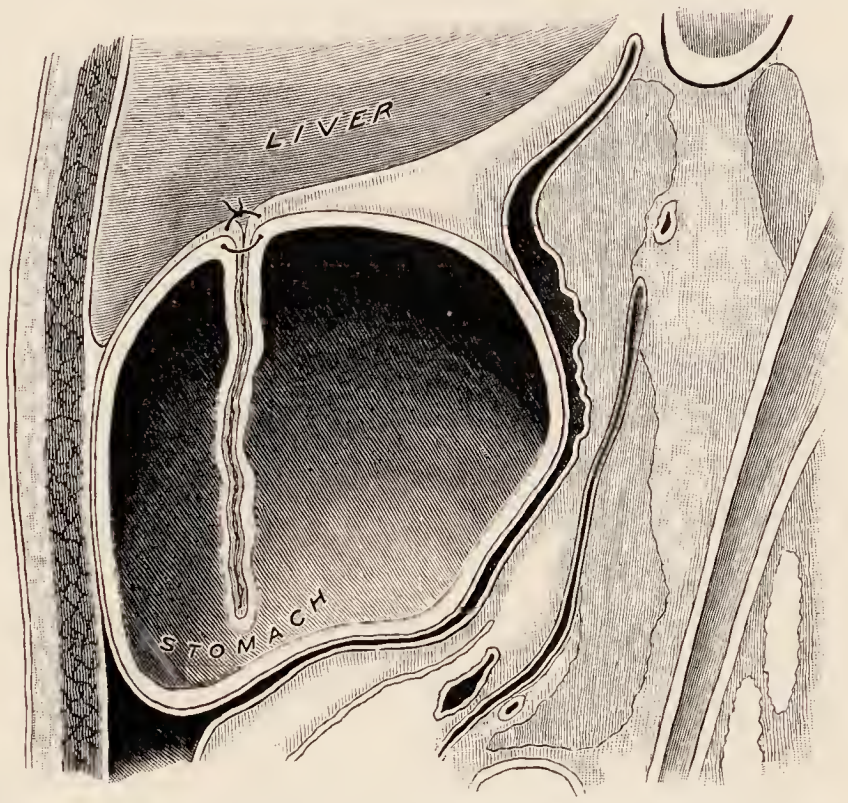



FIG. 1003. — The operation of gastroplication, Bircher's method. Longitudinal section.

*Moynihan* applied to the sero-muscular coats of the anterior wall, from the cardiac to the pyloric extremities of the organ, a series of purse-string sutures, which when tied caused sufficient inrolling of the wall to reduce the stomach to suitable dimensions. The consequent bulgings at either end were so "rounded off" by means of other sutures as to perfect the outline of the organ. This patient had an uneventful recovery. *Brandt* sutured the anterior and posterior walls, using over two hundred sutures, and, notwithstanding the length of the procedure, the patient made a satisfactory recovery.

*The Remarks.*—The utility of this operation is as yet uncertain, except perhaps in those cases in which relief is not afforded by pyloroplasty or gastro-enterostomy, and in these cases final outcome is not yet established. This operation should not be done in cases while suffering from obstruction at the pylorus. The use of gastroscopy, gastrodiaphany (translumination), and skiagraphy is important in recognizing structural changes of the stomach. *Einhorn's* plan of translumination is serviceable in locating the curvatures of the organ and determining the presence and extent of neoplasmatic and other kinds of thickening of the anterior surface. *Robson* reports 28 operations with 2 deaths. *The death rate* of the operation is 7 per cent.

**Gastropexy.**—*Duret* reported in 1896 a case in which he had opened the abdomen and restored a dilated and distended stomach to its proper position by suturing the duodenum and the lesser curvature of the stomach to the abdominal wall. Since then *Davis* has reported two cases of a like nature, in which the patients were relieved by a somewhat similar method employed by himself. Further knowledge of the permanency of the fixation and of remedial relief is essential to establish its status. In 5 cases all recovered.

**Gastrectomy.**—The term gastrectomy relates to the removal by cutting of the whole or of any part of the stomach, therefore partial and complete gastrectomy are proper expressions.

**Partial Gastrectomy.**—The removal of a limited portion of the stomach for the cure of ulcer, tumor, etc., comes under this heading.

**Gastric Ulcer.**—It is estimated that gastric ulcer occurs in from 4 to 5 per cent of the entire population (Ewald), and that the rate of mortality from perforation and hæmorrhage is 6.5, and 3 to 4 per cent respectively. A knowledge of the usual situation of gastric ulcer and of the most frequent seat of disastrous involvement is of great importance in detecting the lesion and determining the prognosis. In 793 cases analyzed by *Welch*, it appeared that the lesser curvature was invaded in 36.8 per cent, the posterior wall in 29.6, the pylorus in 12, the anterior wall in 8.7, the cardia in 6.3, the fundus in 3.7, and the greater curvature in 3.4 per cent of the cases. It is exceedingly important to note the facts, that although ulcer of the posterior surface of the stomach is three and a half times more frequent than at the anterior surface, perforation happens much oftener and is more acutely dangerous at the anterior than at the posterior aspect of the organ. *Brinton* estimates that posteriorly 2, anteriorly 85, at the cardiac end 40, at the pylorus 10, and at the lesser curvature 18 in every 100 perforate. In view of the comparative relations of the seats of perforation, *Keen* emphasizes the wisdom of a methodical search for the lesion, "beginning first with the anterior wall, next the cardia, then the lesser curvature to the pylorus, and ending the search with the posterior wall." Inasmuch as two or more ulcers are present in a fifth of all the cases, the detection of a single perforation should suggest the presence of still another where perforation is impending or complete. Usually the ulcer perforates into the greater peritoneal cavity (Fig. 940, *c*), causing early, pronounced, and extensive peritonitis. Sometimes it opens into the lesser peritoneal cavity (Fig. 940, *b*), producing less pronounced manifestations, but often followed by abscess of the subphrenic type.

**Operation for Perforated Ulcer.**—The indications for treatment are self-evident and should be carried into effect without delay. Nothing whatever should be introduced into the stomach except perhaps the tube of a pump when the organ is filled, to remove the contents, which should be carefully done without flushing. Under chloroform anæsthesia (page 24) make an incision along the umbilicus in the median line, or vertically to the left of this point, as may seem best at the time, enlarging it transversely to the left when required for better exposure and treatment of the cardia, open the peritonæum freely, separate widely the borders of the wound with retractors and expose the operation field to a strong light.

The opening of the peritonæum is sometimes attended with the escape of gas and fluids, confirmatory at once of perforation. If extravasated fluids be present they should be wiped away carefully before further manipulation is attempted, and as search is made they are removed as fast as they appear to prevent infection. If fluids are not present or are of small amount and circumscribed, the prospects are correspondingly favorable. In either instance the contiguous tissues should be carefully protected by gauze pads or flat sponges before the stomach is handled. Examine closely and cautiously the anterior surface of the stomach, utilizing as guides to the defect escaping fluids, deepening areas of congestion, adherent lymph, and the sense of induration indicative of the base of the ulcer. The liver should be raised upward, the stomach pulled downward and forward by gentle traction on the omentum, and adhesions cautiously broken up when necessary for complete observation. The opening is securely controlled by pressure or plugging as soon as discovered, the parts are thoroughly cleansed by wiping, and the stomach is raised well up into the wound, isolated still more with gauze pads, etc., and repair is made by either of the following methods :

Inversion of the borders of the perforation and closure of the opening with one or two rows of Lembert sutures, the same as in typhoid ulcer (page 728). The Halsted suture is especially serviceable. Care should be taken to invert the entire ulcer and provide at its border tissues of sufficient strength to permit of firm and secure union. Excision of the ulcer lengthens the time of the operation without a commensurate reward in the majority of instances. Careful search should be made to detect the presence of a second perforation, and the indications of a prospective one before the stomach is returned to the abdomen. In some instances it is exceedingly difficult to locate the opening because of its small size or obscure location. An ulcer of the posterior wall, when otherwise inaccessible to examination because of adhesions, may be detected through the anterior wall by the finger. In an instance of this kind *Küster* cauterized the ulcer and then performed gastro-enterostomy with a successful issue.

When it is impossible because of thickness or rigidity of the walls of the stomach or the presence of resistant adhesions, or the size of the opening, to apply the preceding method of cure, that of *Barker* and *Dalziel* may be utilized. After excision of the ulcer the borders of the mucous membrane and of the ulcer are brought into contact with each other independently by sutures. In the two instances in which this plan was practiced prompt recovery ensued. *Keen* suggests that greater security might be obtained by supplementing the line of union by the omental graft of Senn. In these cases, when the edges can not be approximated, *Bennett*, in a case of perforation of three inches diameter, and surrounded by indurated borders making sewing impossible, plugged the opening with omentum, which he fixed in place at the borders with four or five sutures and overlapped the whole, as far as possible, with Lembert sutures. This patient made a prompt recovery.

*Braun*, in a case of perforation in which the borders of the opening could not be sutured together, nor to the abdominal wound because of their thin, fragile, and highly vascular state, patched the opening with omentum

by interrupted sutures and performed gastro-enterostomy. This patient left the hospital in five weeks and a half "free from trouble."

*Haward*, in a case of collapse from perforation and in which, because of great infiltration and thickening of the stomach, he was unable to practice excision of the ulcer, sutured the margins of the ulcer to the borders of the abdominal incision, and introduced a drainage tube into the stomach. This patient died six weeks later from purulent processes at the bases of the lungs.

*Paul*, in a case in which he was unable to carry into effect any form of suturing because of the dependent position of the ulcer and the existence of extensive adhesions, resorted to free drainage of the stomach by means of a tube introduced through the abdominal wound into the perforation, and so confined and surrounded with gauze as to conduct the contents of the stomach to the outside. Somewhat later a limited number of cases have received similar treatment, the majority of which recovered. It seems probable that in these latter cases either the omental plug of Bennett or the omental patch of Braun might have proved the better expedients.

After completion of the gastric portion of the procedure infinite care must be taken to thoroughly cleanse the peritonæum, otherwise the most skillful technique will fail to save the life of the patient.

*The Precautions.*—When perforation is suspected the patient should be caused to lie quietly on the back and shallow breathing should be encouraged and even secured when practicable by limiting the movements of the diaphragm. Talking, coughing, and all needless efforts should be avoided. The preparations for operation should be commenced at once, so that prompt action may follow diagnosis and perhaps establish it by explorative incision. The use of the stomach pump should in no way hinder or delay preparations of operative procedure. The needs for stimulation by the most approved methods should be anticipated and provision made for prompt utilization. Finally, it should be indelibly impressed that the additional advantages of early operation may be sacrificed by incomplete preparation, inadequate provision for suitable observation, peritoneal cleansing, and the combating of shock. Observation of the pelvic cavity should be carefully practiced, and suitably located drainage provided in dependent situations when indicated by marked infection. Narrowing of stomach orifices should be avoided.

*The Results.*—Those cases operated on before 1896 and within the first twelve hours show a mortality rate of 39.18 per cent (*Weir* and *Foote*) and 28.57 per cent (*Keen*). The operations since that time give a rate of 16.66 per cent (*Keen*). In operations within twelve hours afterward (twelve to twenty-four hours) the rate of mortality is more than doubled.

**Operation for Non-perforating Ulcer.**—Relief from this variety of ulcer may be had by means of operations that secure rest for the disease, and by excision of the disease and closure of the wound by sewing. The attainment of the former aim is reached by pyloroplasty and by gastro-enterostomy. *Keen* favors the latter because of the "speedy emptying of the contents of the stomach" and the consequent securing of rest. Pyloroplasty is practiced by Morison and Mikulicz, each of whom scrubbed the ulcer

with gauze and then repaired the defect by uniting over it with catgut the borders of the mucous membrane.

*The removal by excision* (partial gastrectomy) of a non-perforating and of a perforated ulcer, although an operation ideal in the conception and perfect in the execution, is open to the strong objection of prolonging the operation without affording an adequate return for the time consumed. Especially is this true in instances of large ulcers: those surrounded by pronounced and extensive induration, those obscurely located, and those attended with shock from perforation or great depression from other causes. However, a sufficient number of successful cases of resection for non-perforating ulcer, especially, are recorded to commend its employment in selected cases. *Rodman* reports 10 operations with 2 deaths.

**Operation for Hæmorrhage from Ulcer of the Stomach.**—As elsewhere stated (page 784), three to four per cent having ulcer of the stomach die from hæmorrhage. The severity of the bleeding is modified, of course, by the size of the vessel involved, being active and promptly fatal in one instance, in another sapping the patient's strength by repeated small hæmorrhages, and finally causing death from exhaustion. In this operation the stomach is exposed through a median incision, and the anterior surface carefully examined by sight and touch for the vascular and indurative changes indicative of deep ulcerative action. The history of the case may not infrequently suggest the site of the morbid process. The examination is carried on as for perforated ulcer (page 785), and with exceeding caution. External examination failing to locate the site of the ulcer, a longitudinal incision is made at the anterior surface, midway between the greater and lesser curvatures, of sufficient length to permit of the introduction of the index finger for conjoined manipulation followed by an increase sufficient to afford ready inspection of the common sites of ulcer by aid of wide separation of the borders of the wound and a strong light. If hæmorrhage be progressing at the time of operation, little or no trouble will be experienced in detecting the bleeding site. If, however, bleeding has already stopped, the surgeon may be much perplexed in finding the seat of the lesion, especially when it is, as often happens, of minute size. The presence of circumscribed induration, of increased vascularity, of an adherent blood clot, and of defined structural changes point to the seat of disease. Careful wiping of the surface with a soft sponge will materially aid in the search. When discovered, the margin of the ulcer may be seized with forceps and brought through the gastric opening, remembering that if the ulcer be located near to either extremity of the stomach it will be wiser to extend the gastric incision correspondingly than to make undue and likely unsuccessful traction for the purpose of withdrawal. If resisting adhesions oppose the traction and also efforts of separation with the finger, it is better that gastro-enterostomy be done without delay. After proper exposure of the ulcer it may be excised, especially if small, readily accessible, and associated with a large vessel. The wound is then closed by sewing (*gastrorrhaphy*) and the part returned. It is evident that the ligature of the bleeding points can not fail to secure the vessel primarily involved. The closure of the ulcer by continuous suture, or, if

small, by tying *en masse* the base of its pinched-up borders, or the loosening by dissection of the borders and their union by sutures, either of which places the ulcer at rest, may be practiced, provided that the vessel involved is securely tied outside of the ulcerated area. The tying may be accomplished by passing a ligature around it from without or from within, grasping at the same time a small part of the contiguous tissues. In either instance, greater security is had by burying the ligature by means of stitches passed through the sero-muscular coats. Measures of the preceding character are often open to grievous fallacies, suggesting, therefore, the need of great discretion in their use. The high rate of mortality attendant upon direct operative practice for the cure of hæmorrhage in ulcer of the stomach emphasizes the wisdom of the prompt performance of the simpler and heretofore more successful measures, pyloroplasty and gastro-enterostomy, not only after hæmorrhage, but also before, in anticipation of the event, when medication affords no practical relief.

*The Results.*—In 13 operations for hæmorrhage, 9 deaths ensued. The *results of partial gastrectomy for tumors* are much better; about 85 per cent surviving.

**Complete Gastrectomy.**—Complete removal of the entire stomach was first accomplished successfully, September 6, 1897, by Carl Schlatter, of Zurich. Before this time eminent surgeons had successfully removed almost the entire organ on several occasions. Connor, of Cincinnati, effected the complete removal so long ago as 1883. But the credit of the attempt was hushed by the prompt death of the patient. Since the announcement of Schlatter's * case, Brigham † and McDonald, of San Francisco, and Richardson,‡ of Boston, have each reported a similar result of their own. Harvie, of Troy, and Delatour, of Brooklyn, have each operated successfully.

*Schlatter's patient* was a female, fifty-six years of age, with complete cancerous involvement of the stomach and softened lymph nodes at the pyloric end.

*The Operation.*—Under morphine-ether anæsthesia and with strict antisepsis an incision was made in the median line from the ensiform cartilage to the umbilicus. The tumor was found to be freely movable, and could be readily raised out of the abdominal cavity. The left lobe of the liver was then raised, the stomach completely isolated with sterilized compresses, and the omental attachments at the greater and lesser curvatures were divided with the end of Péan's forceps, and tied with silk ligatures. The stomach was dragged downward to expose the lower end of the œsophagus, which was then secured high up by Wölfler's clamp. Stillé's forceps was applied close to the cardiac aspect of the tumor, the stomach severed at the œsophageal attachment, and the end of the œsophagus protected with iodoform gauze. The duodenum was then mobilized to as near the head of the pancreas as possible, and two compression forceps were applied to it close together, the inner at the duodenal aspect of the tumor, between

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* Medical Record, December 25, 1897.

† Boston Medical and Surgical Journal, May 5, 1898. ‡ *Ibid.*, October 20, 1898.

which the bowel was severed. The severed mass was then removed, the end of the duodenum protected with iodoform gauze, and the infected nodes were dissected away. Since only with great difficulty could the open end of the duodenum be made to touch the lower end of the œsophagus it was manifestly impossible to unite them by direct suture. Therefore, the duodenal end was invaginated, and a suitable loop of the jejunum was carried up in front of the colon to the lower end of the œsophagus, to which it was connected by serous sutures. A longitudinal slit an inch in length was made into the bowel, and the borders of the mucous membrane of the respective openings were firmly pinned together by a continuous circular silk suture; over this a second was carried, including the sero-muscular coats, followed by a third row of the Lembert variety. The œsophageal clamp, which had been in place over two hours, was then removed, also the one on the duodenum. The abdominal wound was united in the usual manner by silk sutures, and the patient put to bed. The operation lasted nearly two hours and a half, and less than eight ounces of ether were administered. The loss of blood was slight, and the pulse at the end of the operation was 96 per minute, steady, and of fair volume. This patient made a successful recovery. The after-treatment of the case is so important and extended that the reader is invited to consult the original report.

*Brigham's Case.*—The patient, a female sixty-six years of age, with cancerous involvement of more than half of the stomach.

*The Operation.*—Under chloroform-ether anæsthesia and strict antisepsis a primary incision three inches in length was made in the median line between the ensiform cartilage and the umbilicus. The parietal peritonæum and the omentum were adhered together the entire length of the incision. The stomach only was involved. It was freely movable, and a large mass was noted at the pyloric extremity. Because of unusual thickness of the abdominal wall the incision was extended from the ensiform cartilage to an inch below the umbilicus. Complete isolation of the stomach with hot gauze, frequently changed throughout the operation, was carried into effect. Commencing at the greater, both curvatures were freed from omenta by ligaturing with catgut in half-inch sections for three or four inches alternately, thus permitting rotation of the stomach and aiding the separation. The division at the lesser curvature was very difficult because of the greater depth of the omentum at that situation. After freeing the curvatures the duodenum was closed by clamping at two situations. One clamp was applied close to the growth, the other half an inch outside of the first, and between them the bowel was severed. The distal end of the duodenum was cleansed with a saline solution and wrapped in iodoform gauze. The gastro-splenic omentum was then tied and divided, the stomach drawn down, and two clamps were applied—one just above the cardiac orifice, the other to the œsophagus a little more than an inch above the preceding. Between them the œsophagus was divided, and the end treated with saline solution and wrapped in iodoform gauze and the stomach removed. The extremities of the duodenum and the œsophagus could be easily approximated for sewing, but as the patient's condition demanded haste a No. 3

Murphy button was used instead. The abdominal wound was closed and the patient put to bed. The time of operation was two hours and a quarter, the patient losing about two ounces of blood. Chloroform was employed at the beginning of the operation, and substituted by ether, of which about eleven ounces were administered. This patient made a good recovery.

*Richardson's Case.*—The patient, a female aged fifty-three, with cancerous involvement of "practically the whole organ except a small portion next to the œsophagus." No evidence of the disease found elsewhere.

*The Operation.*—The stomach was exposed through a median incision and found to be mobile and affording opportunity for examination of the pyloric and œsophageal attachments, and apparently demonstrating that no difficulty would be experienced in uniting together the ends of the œsophagus and duodenum—a conclusion not sustained by subsequent effort. In extirpating the tumor the omentum at the greater curvature was tied in inch sections with silk for an inch or more beyond the limitations of the disease, being divided as fast as tied, and the posterior wall of the stomach exposed. About five inches of the transverse mesocolon were unintentionally included with the omentum in the section and divided, but prompt approximation of the borders of the opening by sewing secured repair without an unfavorable sequel. The stomach was raised, isolated with gauze, the duodenum closed by tying with strips of gauze, and then severed transversely with scissors. The bleeding points were secured, the lesser omentum was tied and divided the same as was the greater, the stomach drawn downward and outward, the lower end of the œsophagus exposed, clamped, and so divided transversely as to form a bell-shaped lower extremity, which was suitably narrowed by interrupted sutures for union with the open end of the duodenum. The tense retroduodenal bands resisting proper approximation of the open ends were tied and severed, thus gaining the additional inch or more needed for safe approximation and union of the œsophagus with the duodenum by means of interrupted Lembert silk sutures. The loss of blood was not significant, the shock slight, and the time of operation an hour. The patient made a satisfactory recovery from the operation, but died from return of the disease in about nine months.

*The General Remarks.*—The abbreviated details of the technique of three successful cases of complete gastrectomy are given, but with the admonition that subsequent efforts in the operation should not be attempted without careful study of the reports of the successful and unsuccessful cases in all of their bearings, remembering that not the least in importance is the after-treatment.

**Wounds of the Stomach.**—Wounds of the stomach can be classified as are wounds of the soft parts elsewhere. The position and size of the wound and its outline, coupled with the amount, nature, and degree of fluidity of the contents of the stomach, exercise a marked influence on the gravity of the injury. Also the liability to serious complications of contiguous vessels and viscera should be recognized, especially in those wounds when arising from external violence. Whether or not the injury be limited only to the anterior surface of the organ or involve as well the posterior,

ought not to escape the mind of the surgeon. Nor should the surgeon in doubtful cases of injury on mere assumption delay action so long that the outcome of operative effort will assume the phase of last resort. It is much better, indeed, to reasonably assume the presence of injury, promptly explore, ascertain, and perhaps repair a threatening defect without especial danger, thus securing both comfort and safety, than to hesitate too long at the expense of both. The technique of repair of these injuries differs in no essential regard from that of similar injuries of the intestine. The closure of these wounds by sewing (*gastrorrhaphy*) is accomplished the same as that of the intestines (*enterorrhaphy*). The principles of the use of the gauze pad, isolation of the injured part, and of aseptic agents are identical. The care in the removal from the peritoneal cavity of infecting agents, securing cleanliness, and the establishment of drainage are comparatively similar. In injury of the stomach the possibility of infection of the lesser peritoneal cavity, especially from wounds at the posterior surface of the organ, together with the need of cautious search for contiguous complications, should be kept clearly in view. Gunshot, incised, and ruptured wounds, especially of a plethoric stomach, demand prompt operative practice, even at the risk of deepening the shock. The employment of cocain anæsthesia will not be amiss, especially in those cases of shock and of extended injury contraindicating the administration of general anæsthetics, because of the depression and the physical excitement and dangers incurred from their use.

## OPERATIONS ON THE LIVER, GALL BLADDER, AND BILIARY DUCTS.

The newly devised and somewhat extensive operative procedures relating to these parts of the human anatomy, together with the abnormal deviations incident to disease, require that the salient points of their relative anatomy be given at least a brief consideration. The liver alone is subject to abscess, hydatids, and various other morbid growths. It is liable to traumatism of greater or less extent and severity. The complications incident to the diseases and injuries of the organ are often of greater moment than are the injuries themselves.

### OPERATIONS ON THE LIVER.

*The Anatomical Points.*—The lower border of the fourth rib corresponds to the upper limit of the liver on the right side at the mammary line; the junction of the sixth rib with the cartilage lies close to the upper and outer limits at the left side and in front. The lung covers the liver behind down to the tenth dorsal spine, or to about the ninth rib; posteriorly the liver lies behind the lower ribs, extending from the eleventh upward to the fifth or sixth; anteriorly, at the right, it lies behind part of the ensiform cartilage and the costal cartilages of the fifth, sixth, seventh, eighth, and ninth ribs; in front, at the left, it corresponds below to the tip of the eighth costal cartilage of that side; below the ensiform cartilage it lies superficially and in contact with the abdominal wall, extending downward almost halfway to the navel. For completer detail in these matters the reader is referred to the standard works on anatomy. The downward movement of the liver and




FIG. 1004.—Instruments employed in operations on the liver.

*a*. Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Curved and straight scissors. *e*. Dissecting and mouse-tooth forceps. *f*. Needle forceps. *h*. Retractors. *i*. Sponge-holder. *j*. Drainage tube. *k*. Traction loops. *l*. Chromicized catgut. *n*. Straight and curved needles. *o*. Silkworm, silk, and catgut sutures. *p*. Large and small gauze pads with tails. *q*. Hypodermic syringe. Sponges, wipers, tenacula, costotome, and good light are also essential.

the upward and outward movements of the ribs during inspiration suggest the advisability of confinement of the ribs at the right side during operative procedures on the liver if the patient's safety will permit. The thinness of the liver capsule and the friability of the liver tissue render closure of wounds of the organ a difficult and unsatisfactory procedure.

**Operations for Abscess of Liver.**—The operations for the relief of this affection are of a simple and a radical nature, the former being tentative only in many instances.

*Aspiration.*—Aspiration in hepatic abscess is of chief importance as a diagnostic measure. As a tentative act it removes often to a remoter period the danger of disastrous rupture, thus affording time to prepare the better for the use of severer measures. As a curative means little need be expected of it, not enough, in fact, to justify delay for this reason alone.

*The Precautions.*—Thorough asepsis of the needle by boiling and of the skin by scrubbing, etc., must be practiced to prevent infection of the liver directly by agents connected with the skin or lying within the needle. The needle should be so entered and directed as to avoid the pleura, lung, and deep vessels of the liver and abdomen. The movements of the right side of the chest should be made as quiescent as possible by mechanical means and voluntary efforts during the introduction of the needle, which should be done at expiration. At all events, the outer part of the needle should be permitted to move upward and downward with the respiratory acts, to avoid injury to the liver by the inner part. A small needle can be introduced into the liver in various directions at a single sitting in search of pus, without any special danger, if care be exercised. It is wise to remember that, although pus be present in these cases, the viscidity may prevent its escape through the needle, and thus mislead instead of reassure the surgeon. However, the examination with a microscope of the contents of the needle may throw some light on the exact nature of the field traversed by it. After removal of the needle, the site of the puncture is sealed with collodion or otherwise secured in an aseptic manner.

*A trocar and cannula* of small diameter can be employed with the same precautions as for the needle; the cannula being allowed, if need be, to remain behind for two or three days until serous adhesions have taken place, when a drainage tube can be substituted for it. Since the trocar is larger than the needle, the danger of injury of parts and extravasation of fluids into the peritoneal cavity is increased correspondingly. The trocar is less objectionable in those cases where adhesion of serous surface has already taken place. On the whole, the use of the trocar and cannula can not now be regarded with as much favor as formerly.

*The Operation by Direct Incision.*—After the location, by palpation or the use of the needle, of the most direct site of approach to the abscess, the evacuation can be attained by an operation consisting either of one or of two steps, as the case may require. *If by one step*, make a longitudinal incision of sufficient length down upon the abscess to reach the pus if it be above the peritonæum, and to the peritonæum if below. *If the peritonæum be adherent* to the underlying wall of the abscess, introduce through it into

the abscess an exploring needle of large size, followed by a narrow bistoury, and finally by the finger, thus causing the pus to escape. *If the peritonæum be not adherent*, extend the primary incision to four or five inches in length; arrest hæmorrhage and divide the peritonæum to the full extent of the wound; draw the borders of the wound apart with traction loops and shut off the peritoneal cavity from the proposed site of incision of the liver by an abundance of aseptic gauze; introduce into the liver the aspirating needle, followed by the bistoury and finger as in the last instance. Before the pus escapes by the side of the finger, the borders of the wound are pressed against the liver to shorten the route and facilitate a safer exit. Finally, draw the liver upward with the finger inserted into the abscess cavity; increase the size of the opening with the bistoury; catch the incised borders of the liver with forceps, and evert and hold them carefully in place; sponge out the abscess cautiously, and examine the walls with the finger for other collections of pus. Arrest hæmorrhage by forceps and ligature, or by occlusion of the bleeding points with sutures carried through the border, plugging with sponges or gauze. When bleeding is arrested cleanse the parts; remove the original packing, and cleanse the peritonæum; stitch the borders of the liver opening to those of the abdominal wound, introduce drainage, and dress antiseptically.

*The second step* (Volkmann) is practiced in the absence of peritoneal adhesions and with the view of causing them before opening the abscess. If the condition of the patient will warrant delay after the peritonæum is exposed, it is divided and sewed to the capsule of the liver, and the wound is packed with gauze. The adhesive process can be further stimulated by numerous needle punctures in the membrane before the packing is introduced, but, for the purpose of securing adhesion of the serous surfaces, it is particularly necessary that they should be pressed together by the gauze packing. The abscess cavity should be carefully cleansed by wiping, antiseptic douching, etc., and a very large drainage tube of the proper length introduced before the wound is finally dressed. *Fontan* advises that the wall be curetted carefully, and cites instances of his own (forty) to prove that this measure is not only devoid of danger but contributes largely to the prompt recovery of the patient.

*In those instances in which the operation involves the chest wall* resection of part of a rib or of the costal borders (Fig. 1030) may be essential. It is very important, in instances of pleural involvement in these cases, to unite the pleural surfaces with each other by sewing, if not already adherent, before opening the abscess, otherwise extensive and fatal pleurisy may be provoked by entrance to the pleural cavity of some part of the escaping fluid. *It is sometimes necessary* in these cases *to pass through the diaphragm* to reach the pus, and pleurisy will follow unless precautionary steps be taken (Fig. 1089).

In this operation make an incision about three inches in length parallel with the rib overlying the most prominent part of the abscess. Expose and excise a portion of the rib, carefully avoiding the pleura; open into the pleural cavity by so dividing the subcostal pleura as to form a flap intended to shut off the serous cavity, when properly united with a flap

similarly formed from the serous covering of the diaphragm at that situation; unite tightly the corresponding borders of the serous flaps with fine silk sutures; aspirate the abscess, piercing the diaphragm at the point well calculated to afford suitable flaps for union with the borders of the thoracic wound; withdraw from the abscess cavity a sufficient amount of pus to relax its walls, thus obviating untimely flooding of the wound with pus when the abscess is opened; open through the diaphragm and unite the borders of the diaphragmatic wound with those of the thoracic, plugging if need be the former wound with gauze while the sewing is being done; incise the hepatic tissue at the bottom of the wound, deepening it until the abscess is opened; evacuate the pus and treat the abscess as in preceding instances.

*The Remarks.*—Before opening the abscess greater security is insured by uniting the borders yet more closely with a continuous catgut suture. Smearing the surfaces of the wound with iodoformized vaseline can do no harm, and it may do much to prevent infection. If deemed advisable after union of the borders of the costal and diaphragmatic pleuræ the wound may be plugged with gauze for four or five days to establish adhesion, remembering that the consequent inflammatory changes may obscure the subsequent steps of the operation.

*The Precautions.*—Strict asepsis and rigid enforcement of peritoneal protection are essential to a happy outcome in these cases. Exploratory aspiration may be followed by fatal leakage, if too large a needle be used. Perforation of a large vessel has arisen in this connection. Rough examination of an abscess cavity has given rise to fatal bleeding from rupture of a large vessel, hence caution is essential in this measure. In some instances serous adhesion may not have taken place, even in the presence of evident pointing of the tumor.

*The General Comments.*—A free opening of the abscess should be made when the local evidences indicate the probability of a more or less prompt evacuation through rupture of its wall externally. Yet it is not proper to wait for these manifestations, since rupture at a less favorable situation may happen without their presence at all. When it is determined that pus exists in the liver, its prompt removal is demanded, not only to limit the further destruction of liver tissue by extension, but also to obviate the greater danger of loss of life from rupture. Usually the local evidences of tumor are noted in the right hypochondriac or epigastric regions. In rarer instances less marked evidences of lateral and posterior thoracic involvement are observed. If only constitutional symptoms are present, the use of the aspirator is advised to detect the presence and indicate the location of the pus collection, the needle remaining as an unerring guide to the pus when found. In doing this after the peritonæum is reached, care should be practiced to introduce the needle at the center of the area of adhesion, and the caliber of the final opening should, if practicable, be limited to this area to avoid peritoneal infection. If the area do not correspond to the opening in the abdomen, the opening should be shaped to conform to proper drainage requirements. If disconnected abscesses be present in the liver, one or more may escape notice even if careful examination of the abscess cavity be made with the finger,

trocar, etc., after evacuation. Little can be said in favor of the employment of cautery or caustics for the promotion of adhesion, or of the former for opening the abscess. Abdominal incisions like the thoracic are made over the most prominent part of the tumor about three inches in length and in the long axis of the body. The sewing of the tumor to the edges of the abdominal wound after evacuation of the pus, is facilitated by drawing the organ forward with the hooked finger and by passing all of the sutures before any are tied. After completion of the first step of the operation the introduction of two ligatures but a short distance apart into the tissues at the bottom of the wound, at the site of the proposed opening, will enable the surgeon to draw the structure forward into the wound and also will provide a satisfactory guide to making the incision after adhesions are established. The drainage tube should be maintained at such a length that impingement of the end on the wall of the abscess will not happen as penetration of the liver may follow, especially when the dressings are firmly applied. Curetting of the wall of the abscess, if done at all should be conducted with great caution to avoid the bleeding incident to severance of large vessels. If hæmorrhage occurs flushing of the cavity with hot antiseptic fluids and packing with iodoform gauze should be employed.

*The Results.*—In the absence of sepsis or peritonitis the patient usually makes a prompt and satisfactory recovery. The abscess shrinks and finally heals with cleansing of the cavity, good drainage, and repeated dressings.

The general rate of mortality is about 40 per cent. Individual reports give more encouraging results: as, 48 cases with 35 recoveries (Dabney); 47 cases with 37 recoveries (Ferron); 80 per cent of recoveries are reported by Fontan, which good result he attributes to the use of the curette. Multiple abscesses—40 per cent—are usually fatal. Abscess of the right lobe resulted fatally in 50 per cent, and of the left in 43 per cent of the cases.

**Hydatids of the Liver.**—The liver is the seat of hydatid disease in nearly sixty per cent of the cases of hydatid infliction, and when multiple the liver is quite certain to be involved. The plans of operative cure are those directed to the destruction of the growth without, and with removal of the contents. Addressed to the former plan are: 1, Simple puncture; 2, puncture with removal of a small amount of the contents of the sac; 3, puncture with medication of the contents; 4, electrolysis; 5, incision; 6, excision. Aspiration with removal of a portion of the fluid is thought by some to be a comparatively safe and efficient operation, and often quite as serviceable as the more complicated and dangerous practice of introducing chemical solutions.

*The Results.*—The first and second plans of practice are commended by their outcome. A mortality of 19 per cent, 46 per cent of failures and 54 of successes, is reported (Thomas). Puncture as a means of diagnosis but not of treatment is commended. The third method gives a higher mortality rate than do the succeeding ones, and therefore is not to be employed except for special reasons. Electrolysis with simple puncture is no less dangerous than the preceding, but much inferior to them as a method of cure. Puncture exposes the patient to the dangers of peritoneal infection from leakage and death from hæmorrhage due to the piercing of a large vessel. The securing

of adhesion before puncture, accomplished by incision, packing, etc., the same as in abscess, is a wise measure.

*The Treatment by Incision.*—Incision carried into effect either in one or two stages in the manner practiced for abscess of the liver is the best means of treatment. Ordinarily the cyst can be approached through an abdominal incision; sometimes, however, the posterior thoracic is demanded, depending on the point at which the cyst manifests its presence.

*The treatment by excision* of the cyst wall and by resection of a portion of liver infested with these cysts has been done successfully, but not yet with sufficient frequency to fix their comparative value. Excision, while ideal in its technique, exposes the patient to dangers which are not of special account in the treatment by incision.

*The General Remarks.—Hepatotomy* for the cure of hydatids differs in no essential part of its technique from that directed to the cure of abscess of the liver. The seat, size, depth, and direction of the incision, the provisions against peritoneal infection, the establishment of drainage, and the adjustment of the wound borders, are like the similar considerations in the treatment of abscess. Briefly stated, after a single diagnostic aspiration, *make an incision* down upon the tumor, sew the borders of the peritonæum to the tumor, remove the fluid portion of the contents with the aspirator, make an incision into the cyst an inch in length, and sew the borders of the opening to the non-cutaneous portion of the borders of the abdominal wound; empty the cyst with the fingers and a spoon, examine the inner wall for additional growths and for abscess, cleanse the parts, drain, and dress antiseptically.

The tension of the cyst wall causes prompt and forcible expulsion of the contents as soon as it is punctured. The toughness of the wall often permits the pulling of the cyst outward, between the ribs or elsewhere, for safe drainage, and even its entire removal from the liver. *Thornton* advocates primary closure of the wound.

*The Results.*—The general rate of mortality by the direct methods varies from fourteen to forty-eight per cent; the former rate belonging to the two-stage operation directed to the primary attainment of adhesions (Volkmann). In abdominal approach the mortality rate is 10.29 per cent; in the thoracic —one stage—29.4 per cent (Thomas).

*Hepatectomy* is practiced for the removal of solid tumors of the liver of various kinds. The form, location, size, number, and nature of the growths exercise a great influence on the attempts and the results of operation. Pedunculated neoplasms, those of small size, single, and of benign character, can be removed successfully when accessible and superficially located. In those of sessile form and those more or less completely hidden beneath the liver surface, free incision close to the growth and enucleation are employed. An isolated malignant growth, and even two or many such growths when small and closely associated, may be removed singly by wide free dissection and by resection of the portion bearing them, especially when located at the margins of the right, or in the left lobe of the organ. The difficult part of hepatectomy relates primarily to the control of hæmorrhage and the preven-

tion of air embolism; secondarily to the prevention of sepsis and peritoneal complications.

*Pedunculated tumors and such others* as may be grasped at their bases by an elastic ligature, and even a portion of the liver itself that can be similarly treated, are attacked in one or two stages and removed.

*The Operation in One Stage.*—After thorough asepsis and under generous anæsthesia, make an incision in the abdominal wall over the tumor from the costal margin vertically, five or six inches in length; expose the parietal peritonæum, arrest hæmorrhage, open the peritonæum the entire length of the wound, bring upward into the wound the portion of liver to be removed, causing the base to be brought into close contact with the margins of the wound to which it is united by silk sutures passed through the liver substance beyond the diseased area, thence through the borders of the abdominal wound, and so tied as to firmly unite the liver with the abdomen, and causing the diseased portion to appear without; place an elastic ligature

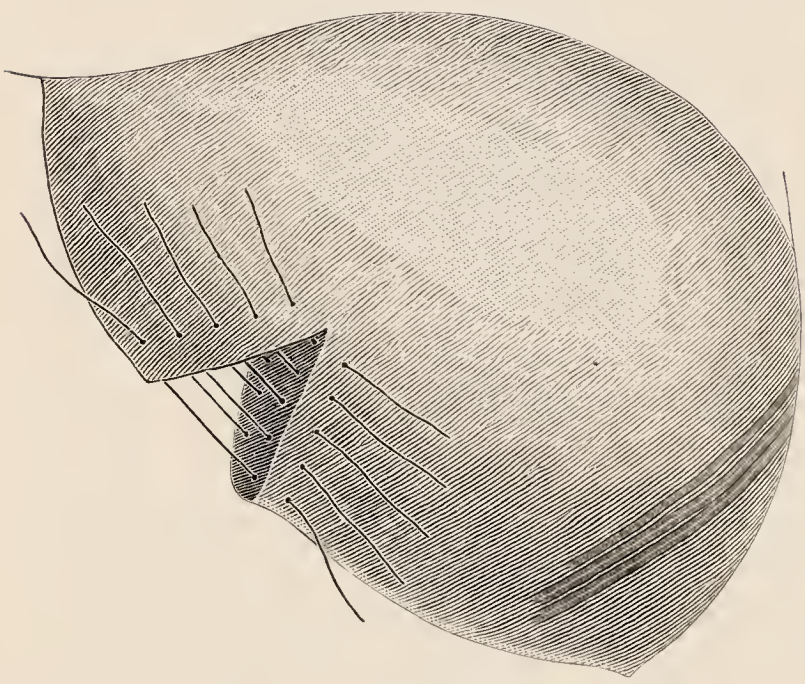


FIG. 1005.—The operation of hepatectomy. Removal of transverse wedge-shaped piece from free border.

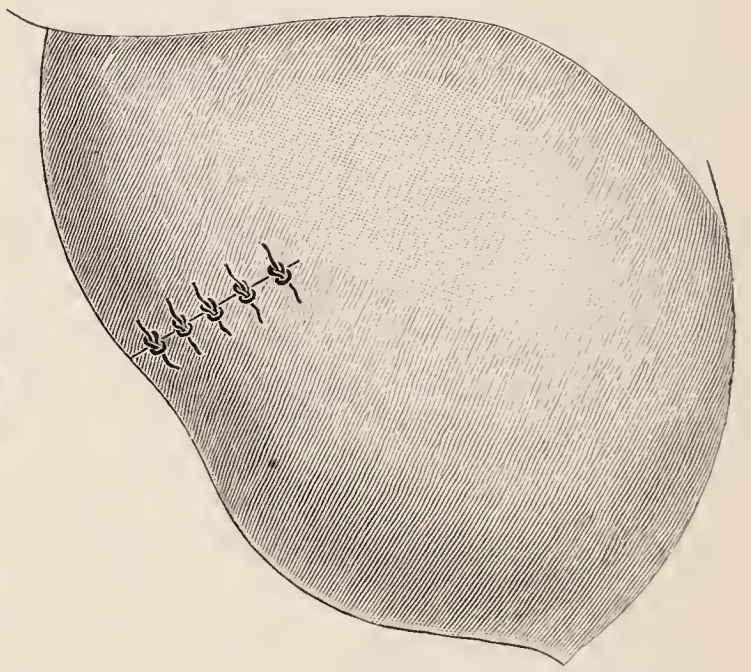


FIG. 1006.—The operation of hepatectomy. Suture of wound.

around the base of the protrusion, allow it to remain for three days, then remove and substitute another. After removal of the mass its base heals by granulation.

*The Remarks.*—The use of the actual cautery during the later days of treatment will hasten the separation and lessen correspondingly the putrefactive changes and the dangers of abscess and suppuration of the wound. The elastic ligature is held in place and guided by means of long, curved transfixion pins passed transversely through the base of the part to be removed.

*The Operation in Two Stages.*—In operation in two stages the first is identical in its scope with the preceding, and is supplemented with packing the wound with gauze for five or six days to secure adhesion between the liver and abdominal wall. The second stage contemplates the removal by dissection or cautery of the exposed portion of the liver, and in the same manner as is practiced in the one-stage operative procedures. As before

remarked, hæmorrhage and air embolism are important complications in this procedure. The former is controlled and the latter prevented by sponge pressure following closely the cutting agent. Circular constriction of the operative field with a rubber tube; application of cautery, ligature of bleeding points with silk, the use of the tamponade, and apposition of the divided surfaces with sutures, quilled (Fig. 140) or otherwise, are the common means utilized to arrest bleeding. In the instances of free incision, especially of a wedge shape, prompt closure of the wound with sutures limits the loss of blood and reduces the danger of air embolism to a minimum. In the removal of deep growths by dissection, the bleeding points are tied as soon as they appear, and the deep borders of the cavity are united by buried catgut sutures, the superficial closed with fine sutures, the part is cleansed, returned to the abdominal cavity, and the abdominal wound closed.

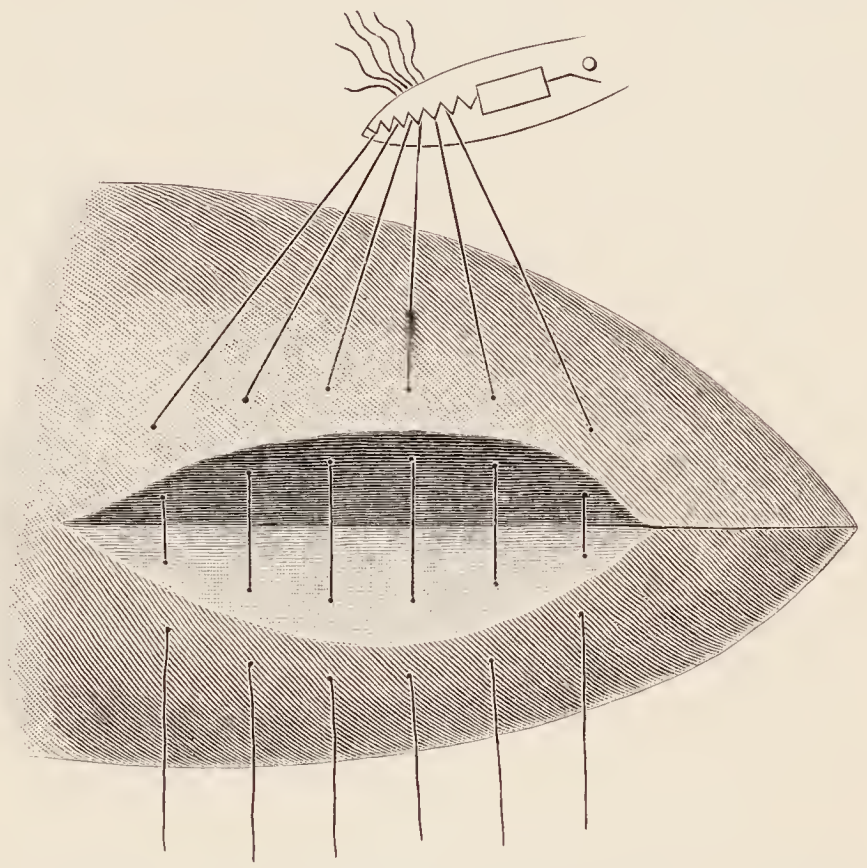


FIG. 1007.—The operation of hepatectomy. Removal of a longitudinal wedge-shaped piece.

*Wedge-shaped portions* of the organ can be removed with antiseptic precautions through a free abdominal incision (Figs. 1005, 1006). Control hæmorrhage by circular elastic constriction; make a curved incision at either side of the base of the tumor, so directed that they meet each other, especially at an acute angle beyond the growth; remove the wedge-shaped piece thus formed along with the morbid growth; relax the constriction, catch and tie the bleeding points with silk as fast as they appear (Figs. 1007, 1008). Cleanse the wound, and close it with deep sutures introduced a third of an inch apart with a curved Hagedorn needle.

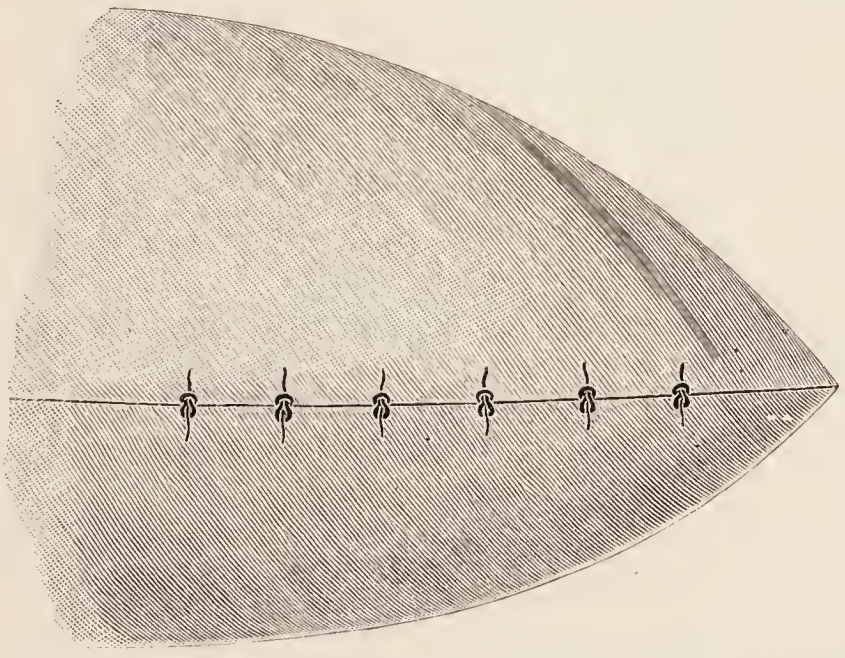


FIG. 1008.—The operation of hepatectomy. Suture of wound.

*The Precautions.*—During operation cover as carefully as possible the divided surfaces with sponge pressure to prevent air embolism. Injury of the important vessels associated with the transverse fissure, especially the

portal vein and its large branches, should be cautiously avoided. Ligature of the latter is liable to end promptly in fatal abdominal hæmorrhage. The free use of cautery for the control of bleeding is objectionable because of its interference with subsequent union. Caution must be exercised in suturing the liver to avoid the tearing out of the stitches; even quilled sutures and stitches carried around strips of gauze may be utilized temporarily for the purposes of better security. In the instance of failure to close a wound of the liver completely by sewing, the remainder of the wound is properly treated by the introduction into it of iodoform gauze, which is allowed to escape externally through the abdominal wound.

*The Remarks.*—In those instances in which excision by cautery is made, the Paquelin cautery knife is especially serviceable. Surgeons have repeatedly removed portions of the liver as well as tumors from its structure with comparative safety.

A large portion of liver can be removed without material injury to the patient; in fact, a third has been removed in the lower animals without a fatal result. Portions removed are speedily replaced apparently by increase in the size of already existing elements, and the functions are promptly restored. Searing the cut surface with cautery prevents the escape of bile from the open ends of the small ducts, and thereby prevents its admission to the abdominal cavity or external wound, as the case may be. Temporary digital compression of the pedicle of a growth or of the liver substance contiguous thereto will limit the flow of blood, and increased advantage in the application of pressure may be gained by passing the finger through the foramen of Winslow. The slow tightening of broad, interlocking silk sutures passed about a third of an inch apart through the liver outside of a proposed line of division will admirably control hæmorrhage. An omental patch, held in place by pressure and stitching, may soon establish an organized barrier to the escape of blood from the incised surface.

*The Results.*—Twenty-one cases are reported with two deaths.

**Wounds of the Liver.**—Wounds of the liver arise from various kinds of violence, especially from blunt and that dependent on falls, etc. The peculiarity of the normal liver structure, and its modification by various forms of structural disease, contribute not a little to the liability of hepatic injury. The right lobe is injured about four times oftener than the left and three times more frequently than the median portion. In injuries of the liver, the characteristic freedom and persistency of the bleeding, and the presence of bile in the peritonæum, suggest the need of prompt operation. Strict asepsis should always be employed. The abdominal incision should be free and so located as to best expose the seat of the injury. The median incision only, or supplemented by another at the right or left, will commonly meet the indications. However, when located high up and well to the right, an oblique incision along the costal border, aided perhaps by excision of a part of one or more of the ribs, may be advisable. Collections of blood in the peritoneal cavity often indicate the seat of the injury, and their removal may furnish the evidence of continuous bleeding. *The indications for treatment* relate to the arrest of hæmorrhage, repair of the wound, cleansing of the

peritonæum, and the establishment of the necessary drainage. Hæmorrhage is temporarily controlled by packing the wound with gauze or sponges, aided perhaps by digital or elastic pressure of the injured part of the organ. The ligature of the bleeding points with silk, and closure of the wound by deeply and closely placed silk sutures are the ideal steps of permanent arrest of bleeding and final repair of the wound (Figs. 1009, 1010). Small ruptures of the surface are closed quite well by means of purse-string sutures (Fig. 816). In the event of incomplete or non-closure of a wound for any reason, a tamponade of iodoform gauze should be introduced for a day or two, as the case may be, depending on the presence and character of the bleeding. The use of cautery in wounds of the liver is objectionable since it interferes with the processes of repair, and invites the occurrence of secondary hæmorrhage. Tampons of sterilized gauze are much prompter and securer agents of arrest than cautery. In gunshot and stab wounds the hæmorrhage is arrested by tampon and such open vessels closed with silk as may be found practicable. The tampons are removed every two or three days with caution, and fresh and smaller ones introduced to facilitate drainage. The abdominal wound should not be completely closed so long as a danger of hæmorrhage or infection is present. The removal of blood clots and free blood from the peritoneal cavity should be carried into effect, and good drainage established when suggested by the possibility of the occurrence of infection.



FIG. 1009.—Sewing rupture of liver with Emmet's needle.



FIG. 1010.—Sewing liver, sutures placed for tying.

It is worthy of note, however, that the presence of blood in the peritoneal cavity is objectionable in proportion to the degree of infection that may be associated with the injury.

*The Results.*—In rupture prompt operative action appears to increase the rate of recovery from 15 per cent to 45, in gunshot wounds from 55 per cent to 70, and in stab wounds from 64 per cent to quite 75.

**Hepatopexy.**—Hepatopexy relates to the cure of abnormal mobility of part or the entire liver by fixation of the organ to the abdominal wall. The requisite incision for fixation is made over the prolapsed part of the liver parallel with the costal border, the liver is reduced to the normal position and retained by means of several stout silk sutures connecting it with the posterior surface of the abdominal wall. The patient is required to lie still for several weeks in order to secure as firm union as possible.

*Ramsy* fastened a prolapsed liver in place successfully by means of strong silk ligatures passed through the round ligament and over the cartilage of the seventh rib and tied, aided by a kangaroo tendon connecting the extreme right lobe of the liver with the abdominal wall corresponding to that point. *Treves* and others have recorded apparently successful issues from the measure.

*The Results.*—The results of the several cases thus far noted seem to justify the course pursued, and encourages a belief in further efforts to remedy the ill effects in Glenard's disease.

**Hepatostomy** (Cholangiostomie).—Hepatostomy consists in the establishment of a fistulous communication between one or more extra-hepatic bile ducts and the surface of the body to relieve the ducts of accumulated bile due to obstruction from biliary calculi. An abdominal incision is made over the portion of the liver harboring the distended ducts, and after careful isolation of the field of operation an incision is made into the liver and deepened until the dilated duct is reached. Careful cleansing of the wound and renewed packing of the field is done before the duct is opened, to avoid the possibility of infection from the escape of its contents. The duct is then opened, the wound carefully cleansed, and the gallstones are removed. The presence of other dilated ducts are sought for and relieved in a similar manner as the preceding. The wound is again carefully cleansed, the borders of the hepatic and gall-duct incisions are united to those of the abdominal wound by sewing, and the remaining portions of the latter wound are closed with sutures, leaving the fistulous opening to heal.

*The Results.—Thornton* operated successfully upon a patient by this method of practice.

**The Operation for the Cure of Ascites from Cirrhosis of the Liver.**—In 1896 *Drummond* and *Morison* called attention to an operative procedure practiced in two instances by the latter for the relief of ascites due to cirrhosis of the liver.

*Morison* opened the abdomen in the median line between the umbilicus and the pubis, removed the fluid by sponging, scrubbed the anterior parietal peritonæum, also the visceral layers of the spleen and liver and the parietal portions corresponding with them. He then united with sutures successively the scrubbed surfaces of the spleen and the liver, and the anterior surface of the great omentum with the corresponding scrubbed surfaces of the parietal peritonæum. The abdominal wound was then closed except at the

lower end, through which a glass tube was passed into Douglas's pouch. The abdomen was then supported firmly by several adhesive strips passed around it, thus maintaining the apposed surfaces in suitable contact for final adhesion. Later *Weir* practiced the plan for a similar purpose and substantially in a like manner. *Brown*, of New York, reports a recent and successful case.

*The Results.*—Fourteen cases are reported, 7 of which appear to have been materially benefited or cured by the operation (Brown), and 3 died from the operation. The many instances of practical cure following tapping and the uncertainty of the exact pathological state of the liver, together with the somewhat formidable character of the operation and the liability of infection, invest the operation at present with a large element of doubtful expediency.

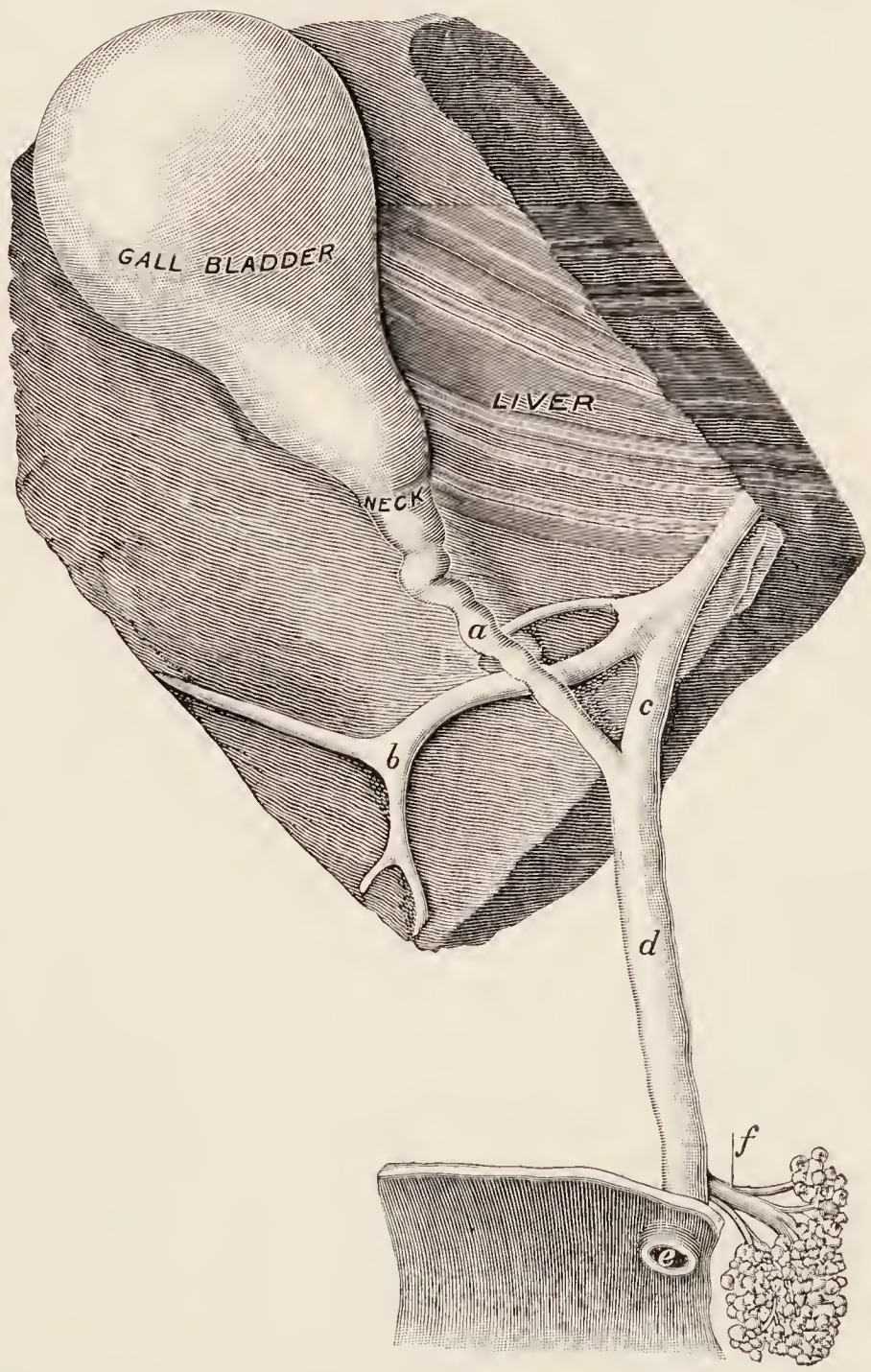



FIG. 1011.—The biliary vessels and gall bladder. *a*. Cystic duct. *b*. Bile duct. *c*. Hepatic duct. *d*. Common duct. *e*. Duodenal orifice. *f*. Duct of Wirsung.

**Operations on the Gall Bladder.**—The gall bladder is frequently operated on for the removal of gallstones, purulent collections, etc.

*The Anatomical Points.*—The normal gall bladder is from two and a half to five inches in length, an inch and a half across at the widest point, holds about an ounce, and contains calculi in about ten per cent of the adult subjects. When filled, the fundus extends beyond the border of the liver at a point corresponding to the cartilage of the ninth or tenth rib, more frequently the former. The upper surface lies in contact with and is attached to the liver by connective tissue, while the under surface and the sides are covered with peritonæum (Fig. 1014). *Brewer* reports the presence of a distinct mesentery in four per cent of a hundred dissections made by himself and in these instances, frequently supplemented by an outward extension of the lesser omentum, thus forming a double mesenteric arrangement. The late *Greig Smith* reported somewhat similar findings. The under surface

lies in close connection with the first part of the duodenum and the hepatic flexure of the colon. The cystic duct is about an inch and a half to two inches long, and lined with mucous membrane so arranged in a spiral manner around the lumen as to narrow the caliber, rarely permitting the introduction of a probe, and resisting the removal of calculi (Fig. 1012). This duct runs downward to the left in the lesser omentum, having the hepatic artery on its left and the portal vein behind it, and joins the hepatic duct at an acute angle (Fig. 1013). The hepatic duct is about two inches long and arises by two branches, one each from the right and left lobes of the liver, and runs downward and to the left in the lesser omentum with the hepatic artery at the left side. The common duct varies in length from an inch and a half to about five inches, having an average length of about three inches, is formed by the cystic and hepatic ducts, and passes at first between the layers of the lesser omentum in front of the portal vein, to the right of the hepatic artery, and behind the first part of the duodenum (Fig. 1014); it then passes between the second part of this intestine and the head of the pancreas and ends by entering obliquely into the lower part of the second portion of the duodenum, lying in the walls of the gut for three fourths of an inch before its termination, which is marked by a small mucous papilla located about three and a half to four inches from the pylorus. *Brewer* points out the fact that the papilla (Fig. 1012) can be located quite well in the living subject by passing the left index finger through an opening made into the second portion of the gut, downward, inward, and backward to a point about an inch and a half below the crescentic fold of mucous membrane located at the flexure indicating the junction of the first two portions of the duodenum, the fold resting opposite the middle of the second phalanx, and its presence being "markedly accentuated by upward traction of the edges of the wound." The general diameter of the common duct is two lines; below its junction with the pancreatic it is three lines. The smallest diameter is at the entrance of the duodenum.

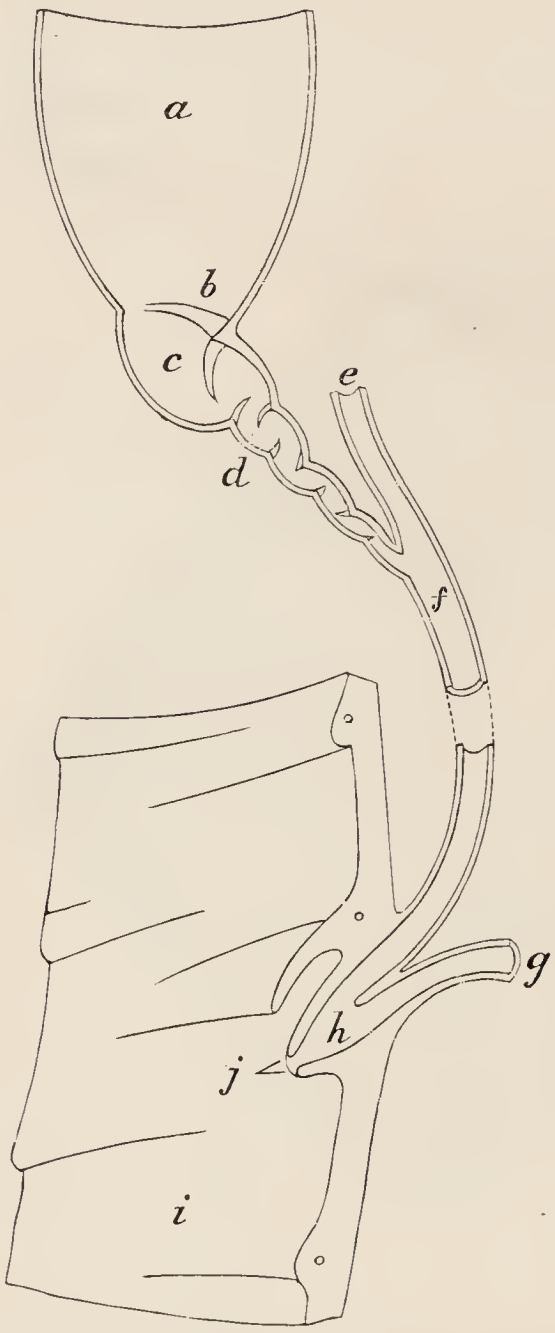



FIG. 1012.—The gall bladder and biliary ducts. *a*. Cavity of the gall bladder. *b*. Neck of the gall bladder. *c*. Cystic duct. *d*. Spiral valve of cystic duct. *e*. Common hepatic duct. *f*. Common bile duct. *g*. Pancreatic duct. *h*. Ampulla of Vater. *i*. Second portion of duodenum. *j*. Biliary papilla.

*The tapping with a trocar and cannula and the aspiration* of a distended gall bladder are by no means trivial matters. Not infrequently a resulting leakage has been followed by fatal peritonitis and death. Neither of these measures can be regarded as wise for the purposes of diagnosis,

as they are less safe as primary measures than is an explorative incision. The latter when properly conducted is devoid of special danger, and therefore may constitute wisely the primary step of complete operative relief. The tapping or aspiration of an exposed and thoroughly isolated gall bladder for the purpose of diagnosis or relief from overdistention is prudent and justifiable practice.

The introduction through the abdominal wall into the gall bladder of a long, slender needle, either independently or combined with trocar and cannula, for the purpose of determining the presence of calculi, is dangerous, and made unjustifiable by the efficacy of explorative incision with strict asepsis and localized anæsthesia.

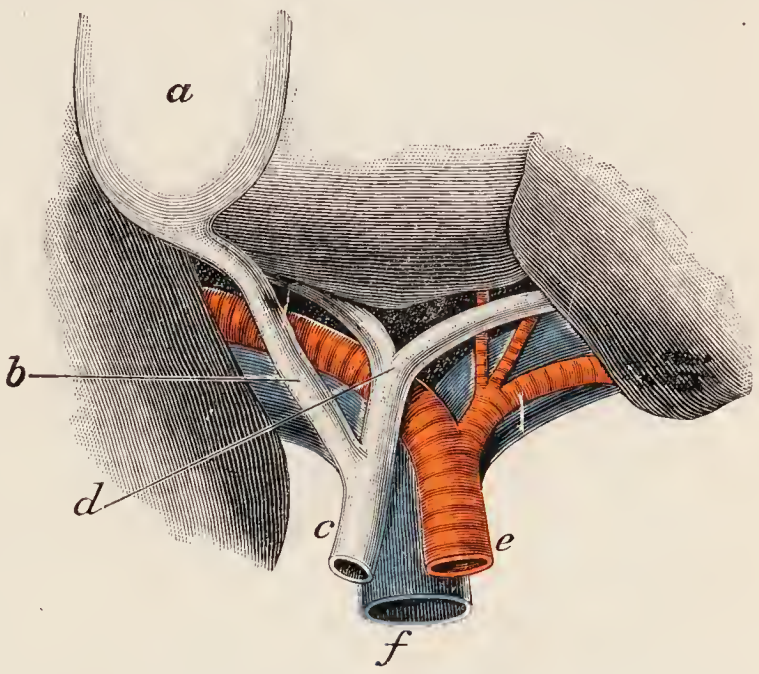



FIG. 1013.—Relation of vessels at and below the transverse fissure. *a*. Gall bladder. *b*. Cystic duct. *c*. Common duct. *d*. Hepatic duct. *e*. Hepatic artery. *f*. Hepatic vein.

**Cholecystotomy.**—Cholecystotomy is a term applied to the operation of opening the gall bladder for the purpose of removal of the contents. The operation may be completed at one or two stages and, in the first instance, the contents of the tumor may be evacuated before or after sewing the walls of the tumor to the borders of the abdominal wound.

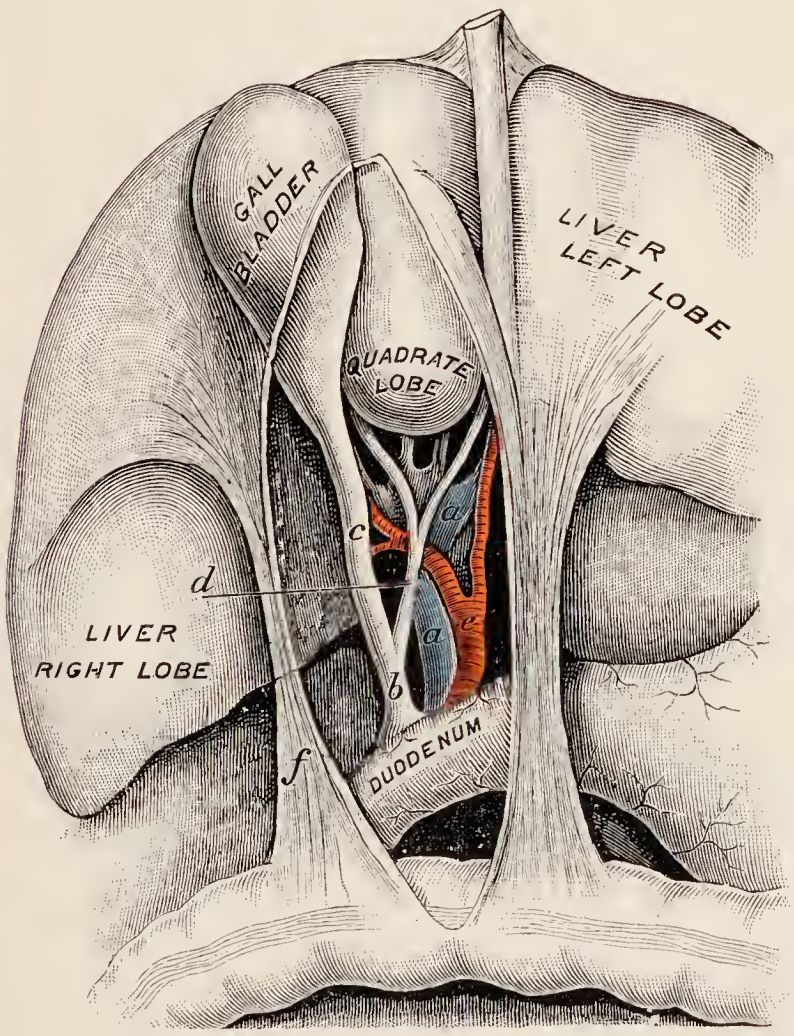



FIG. 1014.—Anatomical relations at the under surface of the liver. *a*, *a*. Portal vein. *b*. Common duct. *c*. Cystic duct. *d*. Hepatic duct. *e*. Hepatic artery. *f*. Hepatico-duodenal ligament—i. e., right border of the lesser omentum.

*The Operation* (primary incision and secondary fixation of the gall bladder to the abdominal wall).—After the necessary aseptic precautions, with the patient lying on the back, locate the cartilage of the tenth rib and make an incision from it downward and forward in the course of the fibers of the external oblique muscle for three or four inches; separate and draw apart the fibers of this muscle and those of the succeeding muscles as they appear (*Greig Smith*); pinch up and divide the peritonæum; introduce the index finger to the abdominal cavity and explore the gall bladder if it be not too much dis-

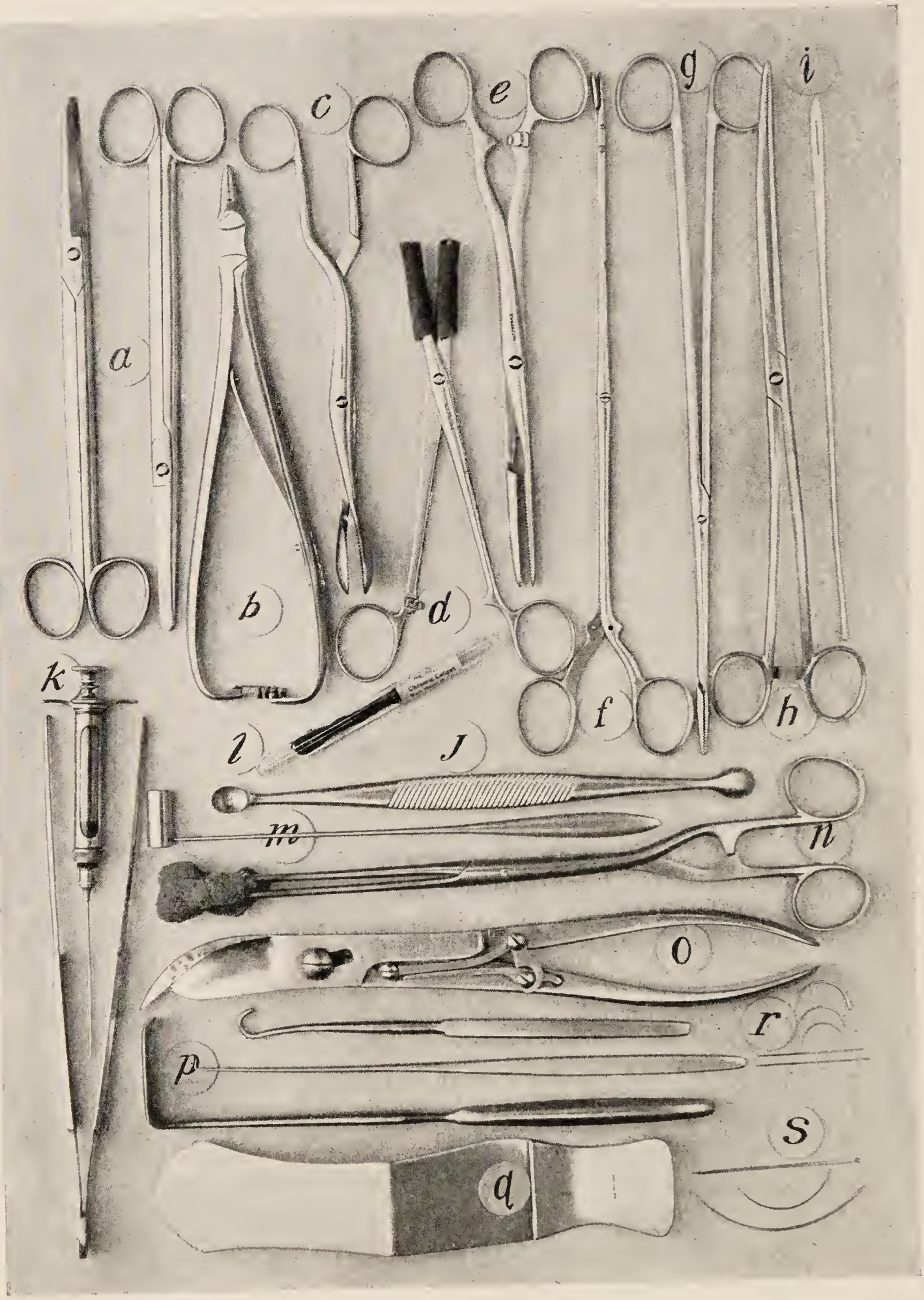



Fig. 1015.—Instruments employed in operations on the gall bladder and gall ducts. *a*. Curved and straight scissors. *b*. Needle holder. *c*. Stone forceps. *d*. Forceps for crushing, with rubber-protected jaws. *e*, *f*, *g*, *h*. Forceps for catching calculi. *i*. Long silver probe. *j*. Scoop. *k*. Hypodermic syringe and mouse-tooth forceps. *l*. Chromicized catgut. *m*. Halsted's hammer (assorted sizes). *n*. Sponge holder. *o*. Costotome. *p*. Blunt hook, tenaculum, and blunt retractor. *q*. Spatula. *r*. Halsted's curved needles. *s*. Curved needles for sewing and straight for breaking calculi. Scalpels, bistouries, forcipressure, ligatures, anchored wipers, etc., are needed.

tended for this purpose; if non-adherent pack the borders of the exposed part of the bladder with gauze or sponges, introduce a small trocar or fine aspirating needle at the lowest point of the exposed part, and as the contents escape seize the relaxing walls of the bladder above and below the point of puncture with fine forceps and draw the bladder cautiously into the abdominal wound and even through it, if the conditions will permit. When the fluid is removed, place a broad sponge around the exposed part and make a vertical incision with scissors into the bladder of sufficient size to admit the finger; grasp the sides of the incision close to the border with forceps, or control them by means of traction loops; draw the bladder still farther forward and give the forceps or loops in charge of an assistant; arrest hæmorrhage; introduce the index finger into the cavity of the bladder and note its contents; remove small stones with a scoop, larger ones with forceps, and liberate impacted ones with the finger or scoop, combined with external manipulation, being careful not to tear or bruise the walls of the gall bladder and cystic duct. Stones immovably fixed in the cystic duct require a special technique for removal (page 813). Having removed the stones, thoroughly cleanse the parts, including the cavity of the gall bladder, with aseptic fluid; remove the sponges, noting that all are accounted for; push aside the intestines and begin a systematic examination of the cystic, common, and hepatic ducts to ascertain the presence of movable or impacted calculi; cleanse the peritonæum and suture the borders of the wound in the gall bladder by continuous or interrupted stitches to those of the abdominal wound, omitting the skin; pass, when feasible, all of the sutures before tying any. Introduce a rubber drainage tube up to the cystic duct that it may better convey away the bile, or close the opening in the bladder around the tube with a purse-string stitch for the same purpose; apply to the wound iodoform gauze and around the tube the ordinary aseptic variety, which is changed as circumstances require. The sutures are removed at the end of a week, the drainage tube being kept in place longer if need be. The resulting biliary fistula will soon close if the common duct be pervious; if not, a permanent fistula will follow which requires special treatment for cure (page 823). If the gall bladder be too much shrunken to permit of its union with the borders of the wound in the manner just described, the peritonæum should be separated and turned upward and sewed to the shriveled edges of the bladder. *Robson* advises that the great omentum be raised up and utilized for the purpose. *Murphy* has modified his button for the purpose, and in writing of the matter, he says: "It can be easily and rapidly inserted deep in the abdominal cavity, though the gall bladder may be very much contracted; it also prevents with certainty the contact of the gall-bladder contents with the abdominal viscera until such time as adhesions have formed around the tube; and finally it leaves a large opening when the instrument is withdrawn from the gall bladder, through which calculi may be extracted."

*The operation with the button tube* is performed as follows: An incision is made in the abdominal wall, beginning at the ninth costal cartilage, parallel to the external border of the rectus muscle for a distance of two and one-half inches. The gall bladder is located, a sufficient surface of its wall exposed,

the contents are aspirated, the purse-string suture is introduced, the gall bladder incised, the male half of the button inserted, and the purse string tied and cut short; the tubular portion of the button is then pressed into position, the tube drawn out as far as the gall bladder will permit, and held there with a pin passed through the openings in the side (Fig. 1016). The isolation of a large drainage tube introduced into the bladder, with carefully arranged iodoform-gauze packing, will soon establish a new and adventitious conduit for the escape of bile.

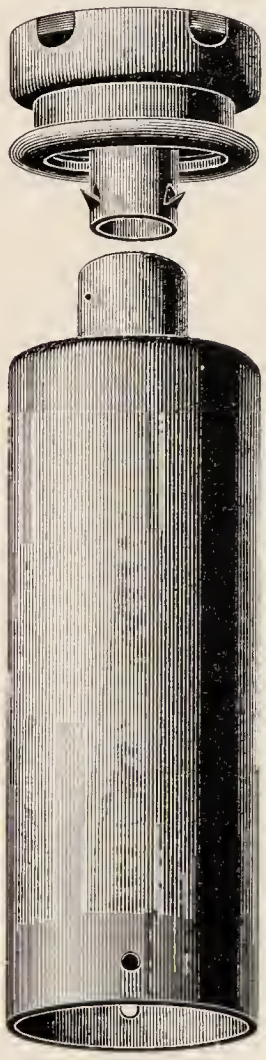


FIG. 1016.—Murphy's modified button for drainage in cholecystotomy.

*The Precautions.*—Soiling of the peritonæum with the fluids, and the loss of sponges in the abdominal cavity, must be carefully prevented. Bruising of the gall bladder by manipulation or forcipressure should be avoided, since sloughing may be the result. The gall bladder should be seized in the line of its proposed division, so that pinched tissue will lead to no significant harm. The aspirating needle should be inserted as low down as possible, so that the puncture will not be obscured by retraction of the gall bladder with the escape of the fluid. The common duct should be examined carefully for permanent obstruction before the gall bladder is sewed to the abdominal wound, and if thus obstructed cholecystenterostomy should be performed. At this time the portion of intestine corresponding to the end of the duct should receive careful manipulative investigation, as a small stone or an insignificantly small morbid growth there may impede the escape of bile. The writer has met with a case of the latter kind. The biliary fistula will close much quicker if the integument be omitted in joining the abdominal wound with the gall bladder. If obstruction of the common duct have escaped the attention of the surgeon at the time of operation, the fistula resulting from its presence can be cured only by removal of the stones. For this purpose a probe can be carefully used to push the stone along. The injection of fluids to dissolve the stone is exploited, but it can not be regarded with favor. The practice of closure of the gall bladder and its return to the abdominal cavity, with immediate closure of the abdominal wound (cholecystendysis), should be practiced with discretion. The temporary advantages gained by this course do not always, in our judgment, offset the dangers that may follow it.

*The Remarks.*—If the bladder be not much distended, aspiration can be omitted and a free incision made at once, the fluid being caught by sponges or conducted away by a small trough of rubber tissue, oiled silk, etc. The direction of the abdominal incision is varied according to the predilection of the operator, the needs for observation and manipulation of the organs, and the preservation of the abdominal nerves. *Keen* advises that it be made parallel with the cartilaginous borders of the ribs; *Czerny* recommends a

right-angled incision, so placed that the fundus of the bladder shall lie between the vertical and horizontal parts of the cut. The "gridiron" dissection of Greig Smith is often of ample dimension, and, like the others, can be extended to meet the requirements by division of the muscular fibers, going even into the rectus abdominis if need be. In this plan the natural tendency of the separated fibers to come together prevents undue subsequent weakening of the abdominal wall at the seat of operation. A vertical incision in the linea semilunaris is convenient for explorative purposes. It may be necessary to break up connecting adhesions before the bladder can be brought into the wound sufficiently to prevent peritoneal infection. If the gall bladder be adherent to the abdominal wall already (one stage), or be sewed to it before evacuation (two stages) of the tumor (primary fixation and secondary incision), there is less danger of peritoneal infection, but the operation is necessarily less complete because of the inability to examine the outlying ducts for the presence of calculi. However, in all other respects the technique is similar to the method by primary incision and secondary fixation of the gall bladder. Cholecystotomy and the removal of the cause demanding the operation implies much indeed, and sometimes more than can be attained. Therefore, the surgeon should be prepared to meet the demands of every phase of the case in an operative sense, and likewise to be reconciled to complete failure in a philosophical one.

*The Results.*—The death rate in the absence of cholæmia is about 5 per cent, and even less in some instances. With protracted cholæmia the rate is increased and is chiefly due to the shock and hæmorrhage provoked by the cholæmic state. In about a third of the cases of operation long standing and persistent, biliary fistulæ have followed, due, in many cases, to faulty observation and technique. More definitely stated, in 161 cases (primary incision with secondary sewing), 46 cases of complete, 48 of doubtful cure, 35 with fistulous termination, and 32 deaths resulted. Of the last, 15 died directly and 17 indirectly from the operation. In 30 cases (primary sewing with secondary incision), 11 were completely cured, 2 uncured, 4 had fistulæ remaining, and 13 died, 6 directly and 7 indirectly, from the operation. In 66 cases (operation in two stages), 42 were cured, 3 unbenefited, 1 improved, 4 had permanent biliary and 7 permanent mucous fistulæ, 1 of doubtful outcome, and 8 died (Courvoisier and Martig). Individual experience (Kehr) exhibits a much better result—i. e., in 96 cases in one stage and 3 in two, all recovered. *Robson* reports 115 cases with 5 deaths; 3 were the subjects of cancer and 2 of suppurative cholangitis with jaundice.

**Cholecystendysis.**—Cholecystendysis consists in closing the opening in the gall bladder, returning it to the abdomen, and uniting the abdominal wound partially or completely at one sitting. When this course is contemplated the ducts should be unobstructed, the opening made into the gall bladder small and near to the fundus, the borders not lacerated, and healthy, the calculi not large, readily removed entire or in fragments, and without the presence of evidences of infection or peritonitis. The reverse of these conditions contraindicate the adoption of the procedure. The margins of the incision and of a rupture of the gall bladder should be carefully united, and

preferably by three rows of sutures. The first row, a continuous suture of catgut, uniting the borders of the mucous membrane; the second of fine interrupted silk, joining together the mucous coats; the third row of a similar kind as the second, and uniting the serous layers after the manner of Lembert.

*The Remarks.*—The plan (Zielewicz) of temporarily closing the cystic duct with a catgut ligature, so as to permit union of the line of sewing before the absorption of the ligature allows bile to enter the bladder, is open to the objection of failure because of lax tying, or the causation of ulceration and stricture on account of too firm seizure and delayed absorption of the ligature. *Czerny's* proposition of uniting the closed margins of the wound in the gall bladder to the peritonæum of the abdominal wound and entire closure of the latter in the usual manner is needlessly unsafe, as the leaving open of a small portion of the abdominal wound will obviate the danger of peritoneal infection without materially delaying cure. Whenever the borders of the opening in the gall bladder are torn or bruised, from rupture or manipulation, they should be trimmed before sewing. Calculi of large size should be broken before removal, and cautiously extracted to avoid bruising of the borders of the opening into the gall bladder.

*The Results.*—In 59 cases 45 recovered and 9 died, 3 directly and 6 indirectly, from the operation. Four of the remainder sustained recurrence and one continuous fistula.

**Cholecystectomy.**—Cholecystectomy is a term applied to the operation of removal of the gall bladder. It is especially adapted to those cases in which the gall bladder is so much shrunken, thinned, or atrophied as to prevent sewing it to the abdominal wound; also to those in which the cystic duct is closed by structural thickening. Limited cancer of the gall bladder, extensive ulceration or rupture, overdistention, with complete closure of the duct and the presence of a persistent mucous fistula, also are indications for the operation. It is proper to say, however, that the removal of the gall bladder presupposes that no gallstones are present in the biliary tract, and emphasizes the hope that none will appear thereafter, since it eliminates one avenue of lodgment and escape, and proportionately measures the gravity of their presence.

*The Operation.*—Expose the gall bladder as for cholecystotomy; isolate the organ from the peritoneal cavity with abundant sponge and gauze packing; turn up the border of the liver; make two parallel incisions, one at either side of the gall bladder, through the restraining peritonæum (Fig. 1014); separate the gall bladder from the liver from the fundus upward to the cystic duct; divide the duct between two ligatures; asepticize the proximal end with cautery; unite the peritoneal flaps with stitches; close the abdominal wound promptly and completely when thorough asepsis is assured, or introduce a small drainage tube leading to the seat of the operation, especially to the end of the duct, if thought wise.

*The Remarks.*—Sometimes adhesions and hæmorrhage complicate the operation, requiring the use of forcipressure, ligatures, etc., and extension of the abdominal incision for a better view and manipulation. Cholæmia pre-

disposes strongly to hæmorrhage, and, when trouble is anticipated, packing of the wound should be practiced for two or three days before complete closure is made. *Mayo* advises removal only of the mucous membrane and cites several favorable results. *Senn* doubts the expediency of the practice.

*The Results.*—The general death rate is about 17.25 per cent, of which 3 per cent are due to individual causes. *Robson* reports the rate at 14.28 per cent.

**Cholecystenterostomy.**—Cholecystenterostomy is the establishment of a biliary fistula between the gall bladder and the intestine, usually the duodenum, for the relief of cholæmia incident to complete division, ulcerative perforation, and irremediable obstruction of the common duct. It is advised also in chronic cholecystitis in some cases and for obstruction of the cystic duct when removal of the gall bladder is not feasible, persistent fistula from irremediable obstruction, and for cholæmia and its tormenting complications in cancer of the head of the pancreas. In a case of the latter kind operated on by the writer the patient was quite promptly relieved of the cholæmia and its inflictions, and lived for three months in comparative comfort.

*The Operation.*—Open the abdomen through a vertical incision three inches in length, located at the outer border of the right rectus muscle just below the ribs; draw apart the borders of the wound with traction sutures; carefully examine the parts and raise the gall bladder and duodenum into the wound and isolate them with aseptic pads; clear the intestine selected of its contents for a space of three or four inches by digital manipulation and clamp the outer limits of the space; insert a needle armed with a silk ligature fifteen inches in length into and through the wall of the duodenum opposite the mesentery and near the head of the pancreas, forming a stitch (purse-string) one third of the length of the proposed opening into the gut; this is repeated at the same side and reversely on the other with an intervening loop, as indicated in Fig. 816. Make an incision in the intestine equal in length to two thirds of the diameter of a Murphy button of proper size (three quarters of an inch); grasp and introduce sidewise one cup of the button (Figs. 812 and 813) and draw the suture tightly around the hub and tie it; aspirate the

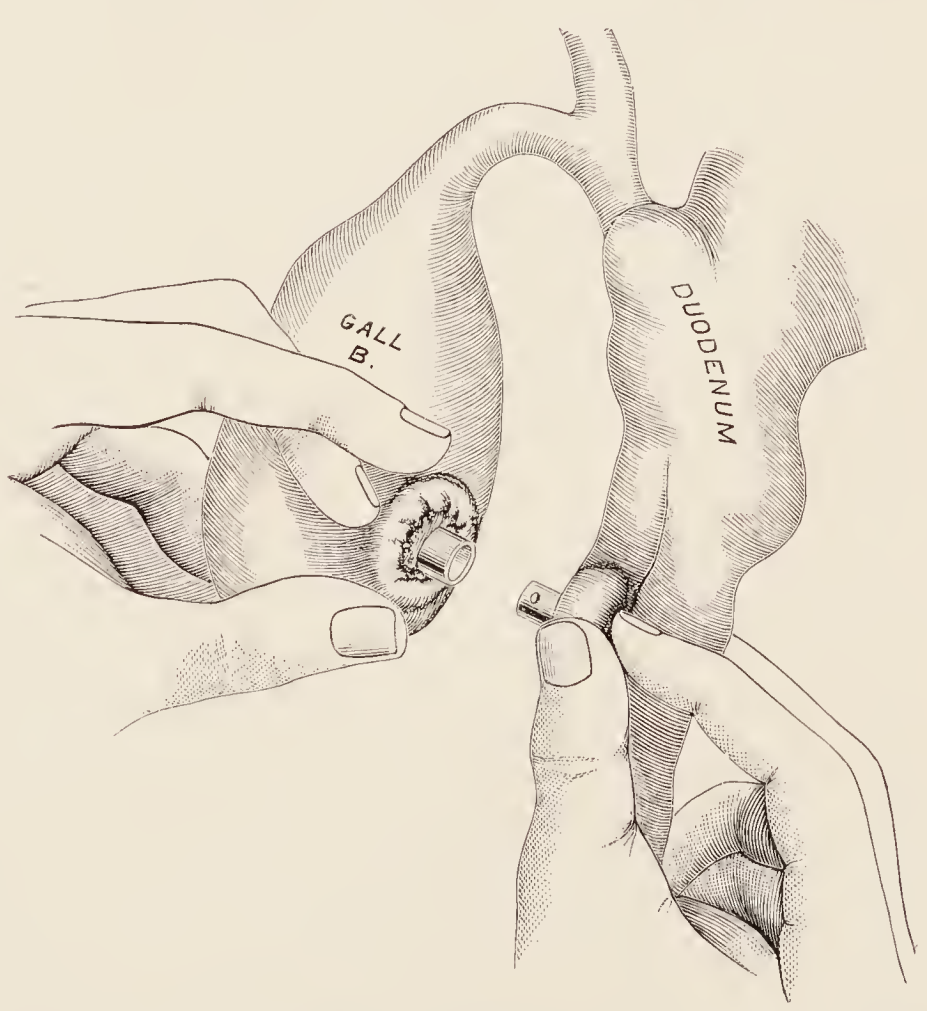



FIG. 1017.—The operation of cholecystenterostomy with Murphy's button.

gall bladder and introduce a similar suture at its most convenient aspect; incise the gall bladder, cleanse it and introduce the remaining cup and tie the suture as before; invaginate the hubs (Fig. 1017) and press the cups firmly together; cleanse the parts, return them, and close the abdominal wound. In the employment of the Murphy button the gall bladder, if much distended, should be treated before the intestine, for the sake of greater convenience and safety. The opening into the former should be so placed as to readily meet the intestine without the distortion of either. Careful isolation should be practiced to prevent the danger of infection incident to removal from the gall bladder of calculous and inflammatory contents. The male portion of the button can be employed in the duodenum more conveniently than in the gall bladder.

*The Remarks.*—The serous surfaces to be approximated are sometimes scratched to hasten the union. The small button constructed by Murphy for this especial purpose has no rival in the surgical armamentarium. The bone bobbin of Robson can be used with promptness and security. In the absence of special mechanism the union may be established by sewing, the same as in intestinal anastomosis and implantation. The anastomosis with the duodenum conforms to the natural entry of bile to the intestine better than an anastomosis with any other portion of the gut. However, whether the increased difficulty of adjustment with this intestine in some instances is met by a corresponding physiological gain is open to reasonable doubt. Anastomosis with the flexure of the colon is very convenient, and thus far has seemed quite satisfactory. Anastomosis with the jejunum and ileum can be readily practiced, but the mobility of these intestines is such as to invite kinking and undue traction, to say nothing of volvulus.

*The Results.*—The beneficent agency of the Murphy button is attested by the loss of but one patient (dependent on the button only) in 38 operations, while by other means 36 per cent died. Later estimates in 143 cases in malignant and non-malignant disease, mostly the latter, show a death rate of 14.08 per cent, with but one case directly attributable to the use of the button.

*Cholecystenterostomy* can be practiced by means of sutures only in one, two, and three stages. In either instance the abdominal incision is usually vertical, three or four inches in length, and located at the upper limit of the right linea semilunaris. In the first instance the gall bladder is brought into the wound, isolated, and the contents are evacuated, the wall is incised for half or three quarters of an inch, the cavity irrigated with an aseptic solution, packed with a sponge and returned to the abdomen. The duodenum or jejunum, usually the latter, is brought into the wound, the contents are pushed aside with the finger, and confined there by means of broad silk traction loops passed around the intestine. A longitudinal opening of half or three fourths of an inch is made in the intestine opposite the mesentery, the gall bladder is returned to the wound, the sponge removed, and the borders of the incisions in the respective viscera are approximated and joined together by two rows of sutures, the inner uniting the mucous borders, the outer the musculo-serous coats, in the usual manner. After removal of the command-

ing traction sutures the parts are cleansed, returned to the abdomen, and the incision is closed in the usual manner.

*In operation by two stages* the gall bladder and loop of intestine are brought into the wound, and contiguous areas of each, an inch long and half an inch wide, are apposed and joined at their margins by sutures including the serous and muscular coats of the respective viscera. The approximated viscera are then returned and stitched to the bottom of the abdominal wound, and the wound itself packed with gauze for five or six days. The approximated structures are then raised upward sufficiently to permit the making of an incision into the intestine, a short distance below the united surfaces, when, with a knife or cautery passed through the opening, an anastomosis is made by freely opening the apposed areas of the respective organs. The divided borders of the mucous membranes of the structures are united with a fine continuous silk suture, the incision in the intestine is closed in the usual manner, the parts are thoroughly cleansed, returned to the belly, and the abdominal wound is closed.

*In operation by three stages* the gall bladder and small intestine are sewed together as in the preceding. The gall bladder is then drawn into the wound, incised, and contents are evacuated, the margins of the gall bladder are united to those of the abdominal incision, the excess of the abdominal wound is closed, and dressings are applied for several days; then a biliary fistula is established. Through the fistulous opening the partition between the gall bladder and the intestine is divided with a knife, and the borders are sewed as before, thus completing the second stage. After three or four weeks the fistulous opening is closed by a plastic operation, thus completing the case.

*The Remarks.*—But little can be said in favor of these methods of practice, except, perhaps, that they may prove serviceable in the forced absence of the better and more acceptable methods by mechanical means.

**Cholecysto-lithotrity** consists in exposing the gall bladder and crushing calculi contained within it by means of the fingers, and by forceps with blades protected by rubber (Fig. 1015) or other suitable agents. The fragments are then forced through the cystic into the common duct, thence escape into the intestine. In the instances of soft and pasty stones this plan of action may be regarded with comparative favor. But, when the stones are hard and the fragments irregular, the danger of so bruising the gall bladder as to cause subsequent ulceration and perhaps sloughing of its wall, followed by peritonitis, seems to forbid a general application of the plan. Finally, it is not at all certain that the fragments can be pushed through the cystic duct, for *Brewer* has shown, in this connection, that even "a soft metal probe" can not be passed through the cystic duct in eight per cent of the cases containing calculi in the gall bladder.

*The Results.*—*Robson* reports two cases, both successful, by this method.

**Cholelithotrity.**—Cholelithotrity signifies the crushing of gallstones in the biliary ducts. *Courvoisier* and *Fenger* have given painstaking consideration to gallstone in its practical aspects. The stone is found at the duodenal end of the duct in 67 per cent, at the hepatic end in 15, and at the

middle in 18 per cent of the cases. One stone is present in two thirds of the cases; in one third, two, and even as many as six may be found. In the instances of single stones the size varies from one to four fifths of an inch in diameter. In 97 cases of cholelithiasis stone was present in the gall bladder alone in 84 per cent, in the gall bladder and common duct in 10, and in the common duct alone in 5 per cent of the cases.

*The Operation.*—After thorough aseptic preparation, make either a vertical incision four or five inches in length from the ribs downward through the outer fibers of the rectus abdominis, or an angular one, with an upper limb three inches in length lying close to the ribs, and a lower one of about the same length running in the course of the fibers of the external oblique. The latter method of entrance affords a good chance for observation; neither method offers any special inclination to weakness of the abdominal wall. A *straight* incision beginning an inch below the eighth costal cartilage and passing through the outer border of the rectus muscle to a point two inches above the umbilicus, or a *curved* one beginning at a point just below and outside the ensiform cartilage and passing downward and outward parallel with the costal border to a point half an inch above the tip of the eleventh rib, will in either instance expose to division only the ninth nerve. The flaps are drawn apart with traction sutures and spatulæ, and the gall bladder is localized, from which the cystic, hepatic, and common ducts, are traced in their order and carefully examined for stone. Large stones can be easily located; small and floating ones are difficult to detect and may escape the notice of the most expert manipulation. If the stone be movable it may be pushed along the common duct into the duodenum with the thumb and finger. If in the cystic duct it may defeat removal by prompt escape to the hepatic duct. If the stone be fixed in the common duct, isolate the field of action from the peritoneal cavity, liver, and intestines, by careful and abundant sponge or gauze packing; raise upward the free border of the liver to afford ample view, then crush the stone by thumb-and-finger pressure, or by flat forceps with each blade covered with rubber tubing (Fig. 1015) (*choledocholithotrity*); or, failing with these, *Tait's* plan of picking the stone into suitable sized pieces, for escape, with a sharp needle passed through the wall of the duct, can be practiced. During the latter expedient the stone is grasped with the thumb and finger to prevent its escape, and also to estimate and oppose the force applied by the needle. If the stone be not too large or too hard, but little harm can come from these means of treatment. After crushing, the operation field is cleansed, the sponges or gauze are removed, and the abdominal wound is closed, if there be no doubt as to the final integrity of the duct. If such a doubt be present, iodoform gauze tents are carried above, behind, and below the seat of the injury, and allowed to escape from a narrowed abdominal wound, remaining for two or three days, after which they are removed, leaving a fibrinous track for the escape of bile. The usual aseptic dressings are applied and anodynes administered for the relief of pain.

*The Precautions.*—Incautious or misdirected manipulations addressed to a movable stone located in the cystic or common duct may cause the stone to disappear instantly into the hepatic duct beyond the reach of human

resource to catch, and for the time defeat the purpose of the operation. The author has encountered an instance of this kind in a stone of the cystic duct in a case of cholecystotomy. The employment of too great pressure may cause laceration of the duct, or a bruising that will be followed by the sloughing of its walls. The needle puncture of the duct should be limited to as few points as possible, and the duodenal aspect of the stone should be attacked first when practicable, to hasten the removal of the fragments. Guarded pressure should be made to prevent the needle from transfixing the duct and passing into the tissues beyond. If the duct be sacculated these methods are objectionable, as detritus may remain in the expanded part and lead quite promptly to the development of another calculus (Fenger).

*The Remarks.*—The gall bladder may be atrophied and inflammatory changes may have caused derangement and matting of the tissues to such an extent as to perplex the surgeon. However, if the foramen Winslowii be patent, the introduction into it of the index finger will bring the common duct between the finger and the thumb, and thus enable one to manipulate the duct its entire length.

*The Results.*—*Waring* reports 11 operations, of which 8 were successful. *Robson* reports 26 cases, all of which were successful.

**Choledochotomy** (*Choledocho-lithotomy*).—Choledochotomy consists in cutting into the common bile duct for the purpose of removing a gallstone. The cystic (*cystico-lithotomy*) and hepatic (*hepaticostomy*) ducts can be opened for the same purpose and in a similar manner, and therefore can be regarded under the same heading. The abdominal incision, localization of the stone, etc., are somewhat similar to like steps in cholelithotrity. The gall bladder, cystic, and common ducts should be examined carefully in the order mentioned, the last noted especially in its relations with the head of the pancreas and inner aspect of the descending portion of the duodenum. In fact, the explorative and operative procedures are similar until opening of the duct is determined upon.

*The Operation.*—As soon as the calculus is discovered in the common duct, the lesser omentum and the duct are drawn into the abdominal wound and the field of operation is isolated thoroughly with gauze pads. Seize the duct with the stone by the thumb and finger; make an incision down upon the stone in the long axis of the duct of sufficient length to permit its dislodgment; raise the stone out with forceps or scoop and remove it; wipe away the escaping bile and blood carefully; introduce a probe through the opening into the duct and sound it in either direction for the presence of other stones; pass the probe into the duodenum to insure the patency of the duct; cleanse again the field of operation; close if practicable the incision in the duct by means of two rows of fine sutures, the first including the wall down to the mucosa, the second the serous covering only. *Halsted*,* in commenting on suture of the bile ducts, expressed himself as follows: "Surgery of the common bile duct is still in its infancy." Further along, in speaking of the utterances of others regarding the "great difficulty" and

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* Johns Hopkins Hospital Bulletin, April, 1898.

"impossibility of sewing the duct," he brought to the attention of the profession the use of the hammers devised by himself for the purpose, saying, "If properly employed they convert one of the most difficult operations in surgery into quite a simple one." *Halsted* exposed the duct at the site of the proposed incision, preferably nearer the duodenal end because of the greater convenience and better opportunity to explore the diverticulum of Vater thus afforded. Two traction loops are then introduced through the walls of the duct, one at either side (Fig. 1018), the duct is incised longitudinally between them, the stone removed, the duct raised from its bed, and the incision opened by the traction loops; the hammer is introduced (Fig. 1019), pressed downward, the duct raised by traction loops, and mattress

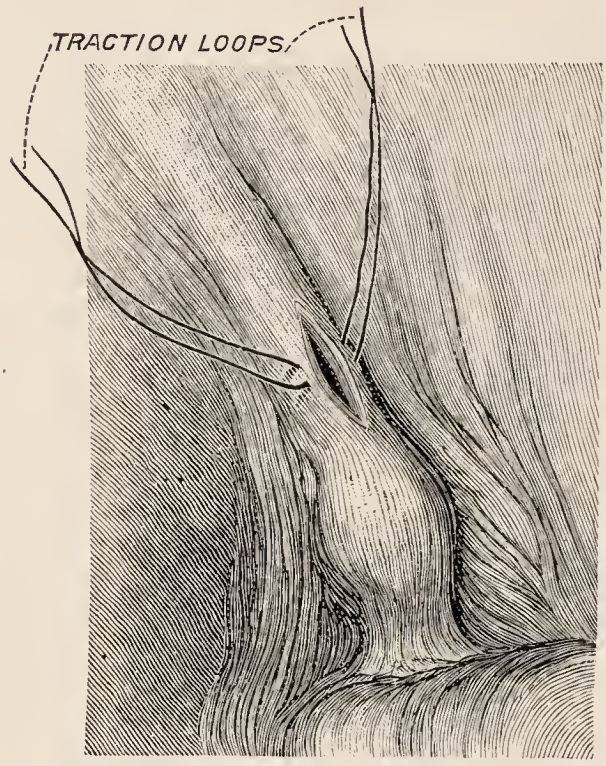



FIG. 1018.—The operation of choledochotomy, Halsted's method. Traction loops at the sides of longitudinal incision.

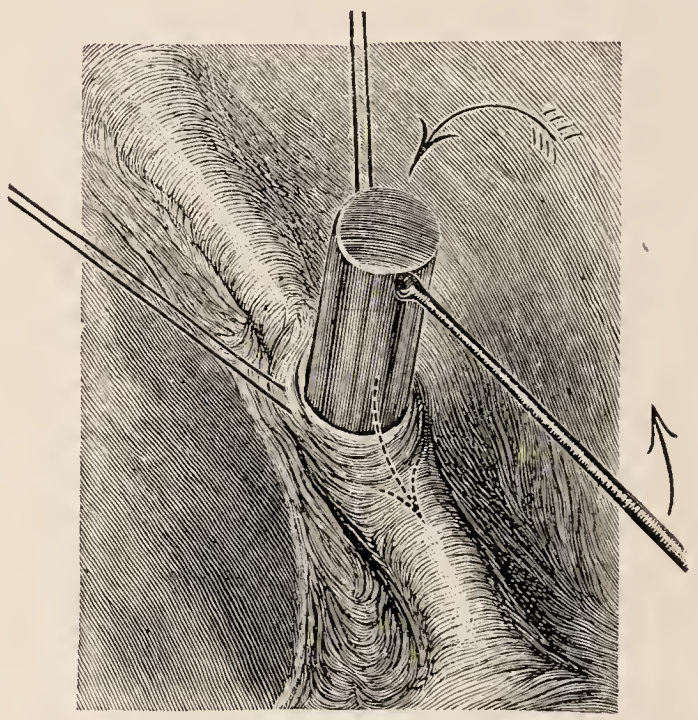


FIG. 1019.—The operation of choledochotomy, Halsted's method. Introducing the hammer.

sutures are applied, one over the heel of the hammer, the remainder at the opposite side of the handle (Fig. 1020).

*The advantages of the hammer* are thus expressed by Halsted:

"1. The duct to be sutured can be drawn toward the incision in the anterior abdominal wall and within easy reach of the operator; it can also be manipulated nicely by the hammer.

"2. The duct, whether normal or thickened and dilated, is gently expanded by the hammer; hence the stitches can be taken with great accuracy and without fear of including the opposite wall or of occluding the lumen of the duct.

"3. The operation is a very clean one, because the hammer blocks the duct and this prevents the escape of its contents and the contents of the gall bladder.

"4. With the hammer, wounds of thin normal ducts can be easily and almost infallibly sutured, and hence the surgeon may, if he chooses, fearlessly operate upon the common duct as soon as the obstruction takes place.

"The sewing of the thickened and dilated ducts is also greatly facilitated by the employment of the hammer."

The silk, the needles, and the needle-holder are each especially provided for the operation (Fig. 1015). A series of hammers with long delicate handles are included in the outfit.

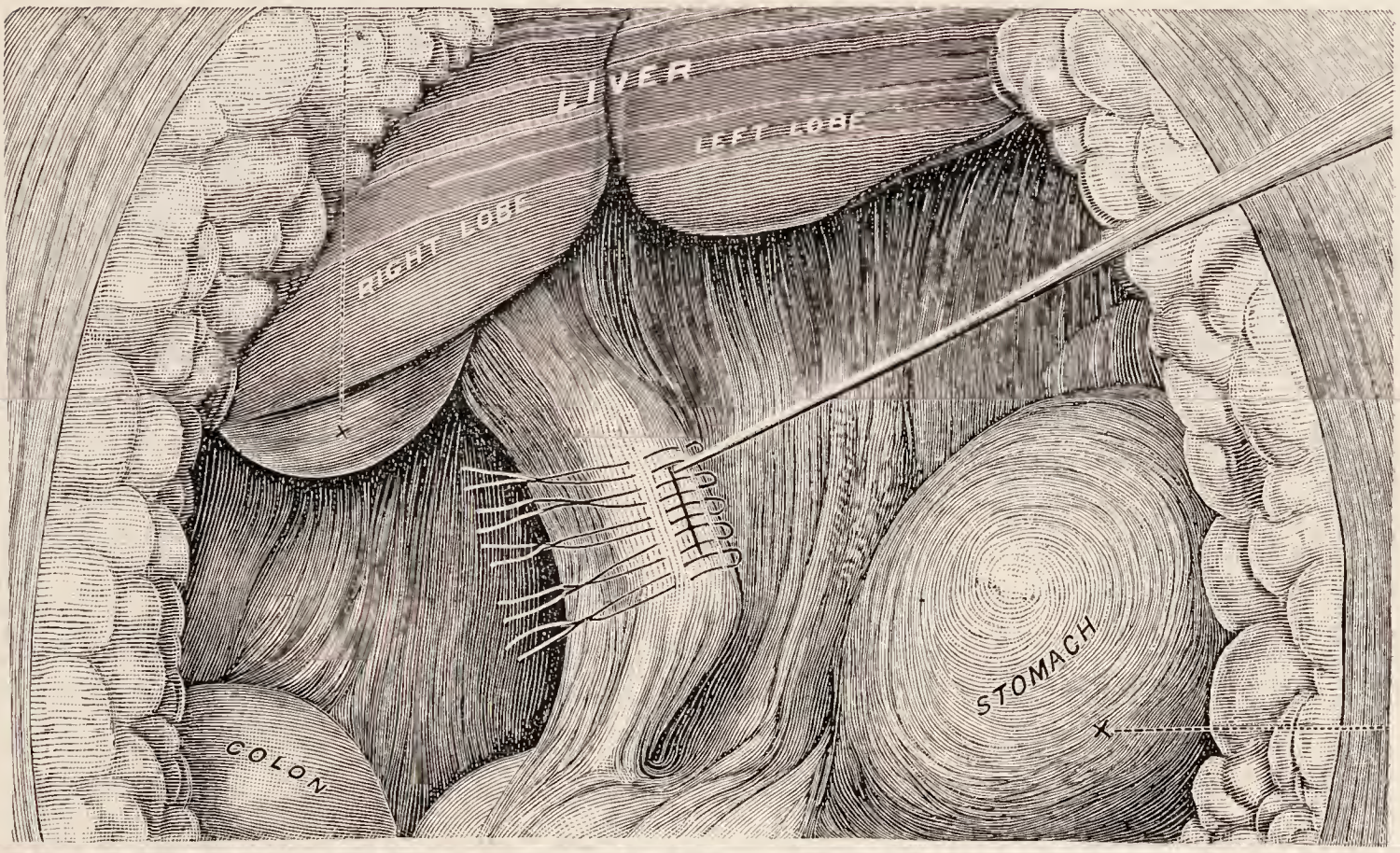



Fig. 1020.—The operation of choledochotomy, Halsted's method. Mattress sutures placed and hammer in position.

If the walls of the duct be insecure for any reason, or the condition of the patient forbid prolongation of the operation, sewing should be omitted and drainage provided instead, by introducing into the duct a small rubber or glass drainage tube, around which is carefully and smoothly placed rubber tissue or iodoform gauze so adjusted at all aspects of the tube and duct as to prevent escape of bile into the peritoneal cavity. The difficulty, pain, and disturbance of parts so often attending the withdrawal of iodoform gauze from the tissues, suggests that this form of gauze be dispensed with when practicable and that rubber tissue be substituted. If this gauze be employed, the objectionable features can be remedied by saturation with sterilized oil before introduction and again before removal, or perhaps quite as well by interposing between the gauze and the raw surfaces rubber tissue. *Abbe* introduced into the hepatic duct through the opening in the common, a drainage tube, over which a larger tube was passed up to the opening in the duct, and outside long strips of iodoform gauze were lightly introduced (Fig. 1021). The inner tube was removed on the second day, the outer on the fifth, the bile passing through them during their presence in the wound. The

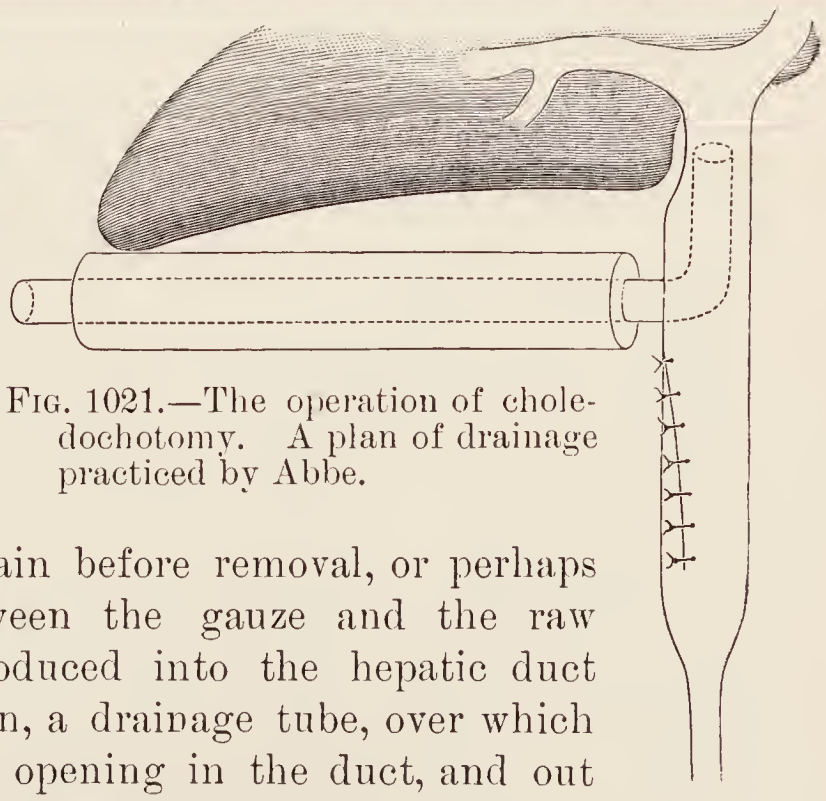


Fig. 1021.—The operation of choledochotomy. A plan of drainage practiced by Abbe.

sinus closed finally in three weeks. Approximation of the borders of the incision with a single suture, or by gauze pressure plus the properly adjusted gauze drainage, answers the purpose quite well indeed. Under all circumstances some form of drainage should be employed and the external wound should not be finally closed until all danger of biliary discharge has disappeared. *Morison* advised drainage through a punctured wound carried posteriorly below the kidney. *Fenger* regards the introduction of the tube into the incision and the insertion of gauze drainage above and below the tube as quite sufficient. *Kehr* in two cases opened the abdomen in the median line between the xiphoid cartilage and the umbilicus, to remove from the cystic duct gallstones that resisted removal from below through a previously existing mucous biliary fistula. The wound of the duct was closed at once and drainage secured through the already established fistula. The presence of an impacted stone in the environment of the duodenal end of the duct or in the ampulla of Vater often requires incision of the wall of the gut to secure its release (*internal choledocho-duodenostomy*). *McBurney* and others have met instances of this kind. With the finger in the intestinal incision the end of the duct may be dilated and the stone pushed into the bowel, or it may be pushed upward farther into the duct and be removed by incision from without or left alone and extracted from within, as seems best.

*The Precautions.*—Infinite care should be exercised in the detection of the site and the exposure of calculi, otherwise the contiguous vessels will be damaged or opened; and especially is this true when extensive adhesions with consequent displacements are present, notably so near the duodenal extremity. In the latter instance the gut should be carefully pushed aside and the wound deepened by blunt dissection. The colon may be invaded in rare instances. Incisions into the cystic duct should be made either at the anterior or posterior surface, to avoid the cystic artery (Fig. 1013) and portal vein. The security of the hepatic artery and portal vein requires that incisions be made in the long axis of the remaining biliary ducts (Fig. 1014). It should not be overlooked that, although healthy bile is aseptic, the influences incident to the presence of calculi in the ducts may establish infection of a serious nature, causing peritonitis, therefore careful arrangement of gauze tents at all aspects of the wound should be made to prevent peritoneal extravasation of bile. If the escape of bile into the peritoneal cavity be free it may invade Douglas's pouch and require removal by means of a tube introduced through an opening made above the pubes. According to *Morison* it readily collects in the limited space between the right lobe of the liver and the colon, from which it may be efficiently drained by a curved incision extending from a little below the tip of the ninth rib to the loin, and even to the outer edge of the quadratus lumborum muscle if additional space be required. After three or four days the gauze may be removed and the rubber tube allowed to remain for a week or so longer. The fibrinous canal formed along the course of the gauze will meet the additional requirements of drainage.

*The Remarks.*—Either the continuous or interrupted varieties of sewing of the duct can be employed; usually the former is selected. Fine, strong catgut or silk, and sometimes both are used, the catgut being employed for

the first row in the latter instance. Many surgeons rely on a single row of sutures only. Fine curved round needles and a long needle holder are the best of the common varieties for use in sewing (Fig. 1015, *a*). Siphonage is applied not infrequently to the drainage tube, but the action is so fickle and so easily disturbed as to render it of uncertain utility. The removal of the gall bladder (*cholecystectomy*) together with a portion of the duct containing a calculus so firmly impacted that it can not be wisely dislodged by manipulation upward or downward is advisable when the structural changes in the duct at the seat of impaction are such that incision (*cystico-lithotomy*) is quite sure to be followed by obliteration of the duct and consequent distention of the gall bladder by its mucous secretion. However, if the walls of the duct are sufficiently healthy to permit proper closure of the incision by sewing, this latter plan is commendable. *Elliot* advises that a small sand bag be placed beneath the back while the body is maintained at an angle of forty-five degrees by straps under the arms. Thus the intestines gravitate toward the pelvis, and with the liver raised up improved observation is gained. Pressure on the duct above the stone with the fingers, before the incision is made, will prevent the free escape of bile when the stone is removed (Fig. 1022); and at this time the patency of the duct beyond can be determined with a probe, and also the sutures may be laid before the stone is raised from its bed (Elliot). Traction loops introduced at either side of the duct (Fig. 1018) before making the incision are of great use in the introduction of the sutures. However, one should cautiously observe before the opening is closed that no calculi remain behind. Occasionally an obstructed common duct becomes very much overdistended, sufficiently in fact to cause a tumor of pronounced character. In a case of this kind, *Winiwarter*, through an incision in the linea semilunaris, established a communication between the dilated duct and the cutaneous surface (*choledochostomy*). The patients thus far treated by this method have succumbed. *Sprengel* anastomosed successfully a greatly dilated common duct with the duodenum (*choledocho-enterostomy*) (page 820).

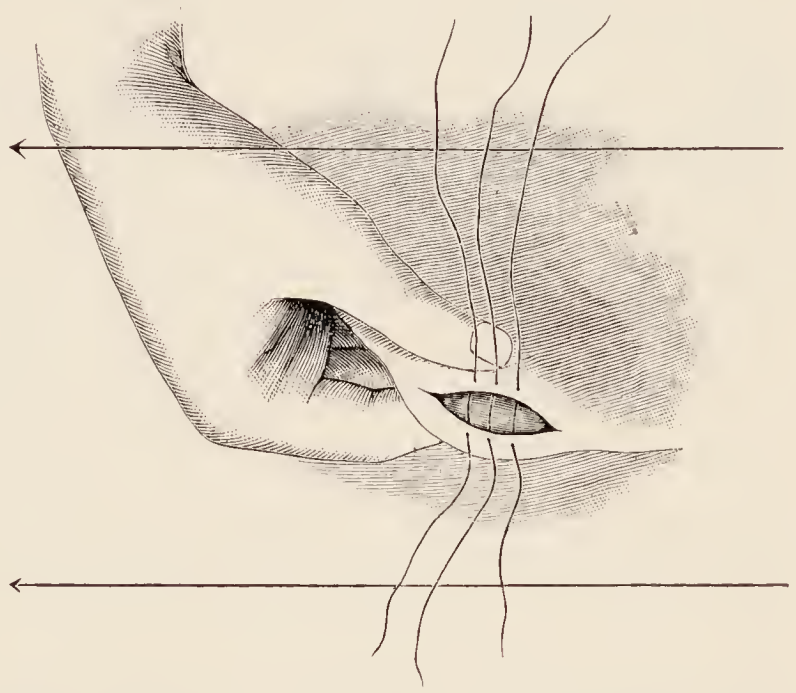


Fig. 1022.—The operation of choledochotomy. Compression of duct, exposure of stone, and placing of sutures.

**Choledochotomy** (*Lumbar Route*).—Posterior or lumbar choledochotomy was studied from its theoretical side by Tuffier and Poirier (1895). The lumbar route has been practically utilized in man by Wright, Mears, Lange, Bogajesky, and several others.

*The Operation.*—Place the patient on the left side, raising the right by a cushion under the flank; make an incision over the right lumbar region, as in extirpation of the kidney. Expose the kidney and colon, isolate the

upper extremity of the kidney, and raise and hold it against the false ribs by the fingers or a retractor; seek for the duodenum, first exposing the ascending portion, then the second portion, and finally the pancreas. Carry inward and shield the vena cava inferior, while the second portion of the duodenum is pressed outward; introduce the left index finger into the wound, pulp inward, and expose the "vasculo-biliary mass" as it descends from the liver (Tuffier), or obtain a view of the bottom of the wound, and locate and isolate a large cordlike mass descending from the liver toward the duodenum, consisting of two or three lymphatic ganglia, large veins, the posterior branch of the pancreatic-duodenal artery, and the gall duct. In either instance isolate and denude the duct in its retroduodenal and intrapancreatic portion, by the aid of long forceps and a grooved sound, as far as possible without opening the peritonæum. Determine the situation of the calculus and incise the biliary canal. Remove the calculus, cleanse the parts, and otherwise treat the case as before practiced.

*The Complications.*—The kidney may give rise to obstacles, especially if it is a movable kidney, which often occurs on the right side. In elderly women a degree of superfluous fat may render difficult the localization of the short portion of the duct. But, as the operation would naturally be performed for a calculus, the latter would assist in the recognition of the dilated duct. In working at such a depth there is great danger of accident, especially of opening the portal vein (Fig. 1014). It is evident that when the second part of the duct is alone attacked the operation is extraperitoneal, which is a great advantage, doing away with the need of intraperitoneal sutures.

The operation is comparatively impracticable and unsatisfactory, and ill-adapted to the exigencies of surgical practice. The biliary passages as a whole can not be explored by the lumbar route. This form of intervention can be defended only in those cases where it is necessary at all hazard to reach the duct without going between the liver and duodenum.

*The Remarks.*—As we now have an excellent way of reaching the duct from in front, the operation of lumbar choledochotomy should not be attempted except for some special purpose. *Tuffier* recommends the incision employed in lumbar nephrectomy—one finger's breadth below and parallel with the twelfth rib. *Poirier* says the incision should be carried to the iliac crest. The second part of the duodenum is identified by the absence of peritonæum on its posterior surface.

*The Results.*—The general death rate of choledochotomy varies from 20 to 44 per cent, the special from 8 to 25 per cent.

**Choledocho-enterostomy** can be done with buttons of small size, such as those used by Boari in uretero-anastomosis (Fig. 1023) in a choledochus duct which is very slightly dilated (Fig. 1024), and this in certain cases in which it would be impossible to apply sutures (Fig. 1025).

*Alessandri* has recently contrived a button which is nothing more than a slight modification of Boari's. The terminal portion of the apparatus is so formed that it can be "hooded" within the stump of the choledochus

duct, and the inferior portion is of an ellipsoid form. To manipulate the apparatus the stylet which serves to separate the tissues may be round instead of ovoid or quadrangular, for in this way the button can not turn upon its

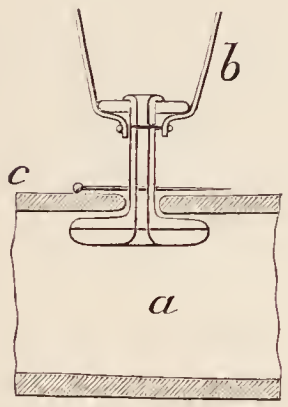



FIG. 1023.—The operation of choledocho-enterostomy, Boari's button in position, transverse section. *a*. Intestine. *b*. Common duct. *c*. Intestinal wall.

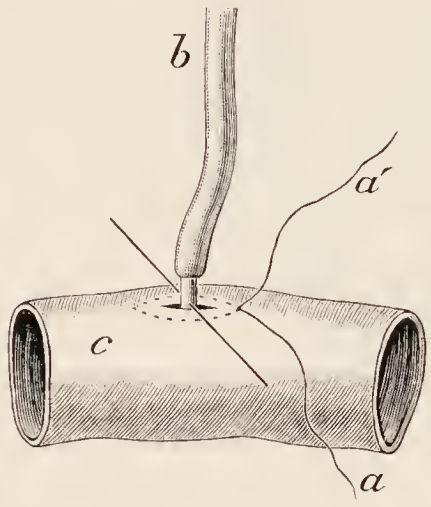



FIG. 1024.—The operation of choledocho-enterostomy, Boari's button in position. *a*, *a'*. End of purse-string suture. *b*. Common duct. *c*. Intestine.

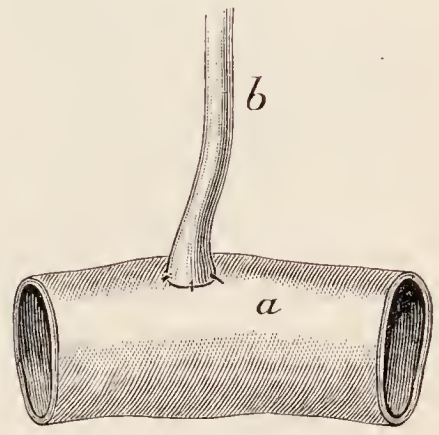



FIG. 1025.—The operation of choledocho-enterostomy, Boari's button, operation completed. *a*. Intestine. *b*. Common duct.

axis. Besides, this button is provided at its extremity with a flange which allows it to be grasped, and which is analogous to that of an ordinary cannelated sound. The manœuvre of introducing the sound is accomplished readily and rapidly.

Surely cholecystenterostomy is preferable to either of these procedures, provided, of course, that the cystic duct be patent. *Waring* considers the advisability of excision of a portion of the common duct (*choledochectomy*), combined with cholecystenterostomy, in localized malignant disease of the

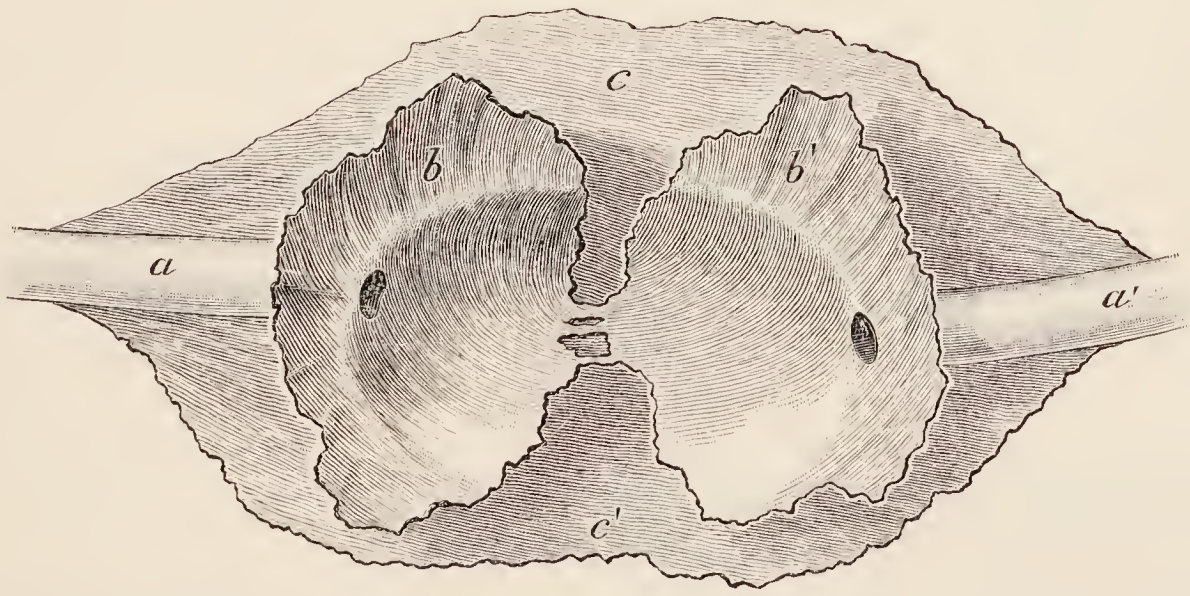



FIG. 1026.—The operation of resection-choledochorraphy, Doyen's method. The hepatic (*a*) and duodenal (*a'*) end of duct. The remnants (*b*, *b'*) of disorganized portion of duct. The flaps (*c*, *c'*) of peritoneal and near-by connective tissues.

duct or extensive papillomata of its mucous membrane and extensive ulcerative and inflammatory changes of its structure. He suggests the removal of the diseased portion by transverse division and the treatment of the divided ends by cautery or scraping. The peritonæum should then be

stitched over the space occupied by the resected part for purposes of repair of the duct and cholecystenterostomy performed. *Waring* practiced successfully on a dog this resourceful plan. Choledochectomy, like the immediately preceding operations, has fortunately but a limited though urgent field of utility.

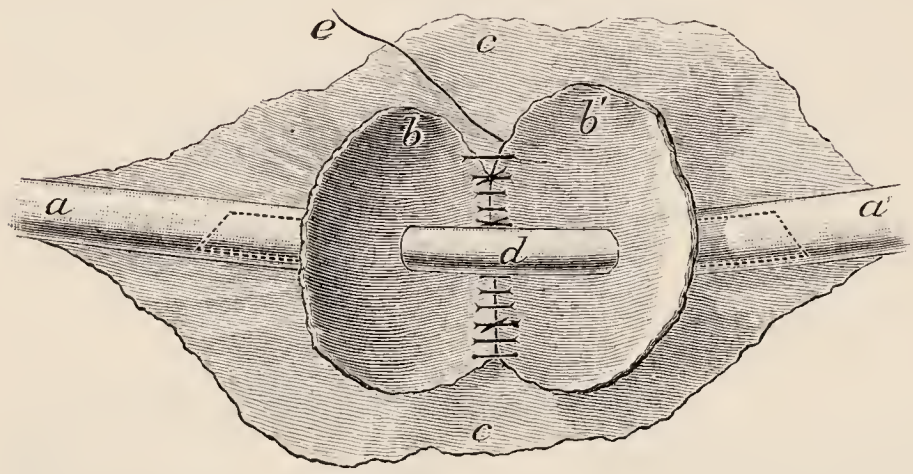



FIG. 1027.—The operation of resection-choledochorraphy, Doyen's method. The hepatic (*a*) and duodenal (*a'*) end of tube. The remnants (*b*, *b'*) of the disorganized portions of duct. The flaps (*c*, *c'*) of peritoneal and near-by connective tissues. *d*. The rubber tube in position.

*Resection - choledochorrhaphy* (Doyen). — The flaps forming the pocket which contained the calculus are utilized for the purpose of this operation (Fig. 1026).

*The Operation.*—After being assured of the permeability of the duct, a tube of red rubber is inserted, one half in the hepatic, the other half in the duodenal side (Fig. 1027), while the torn ends of the canal are approximated by a glover's suture (Fig. 1028). The peritoneal laminæ and near-by connective tissues are carried around the preceding suture and united (Fig. 1029), and the second suture is reenforced by a few wholly superficial ones.

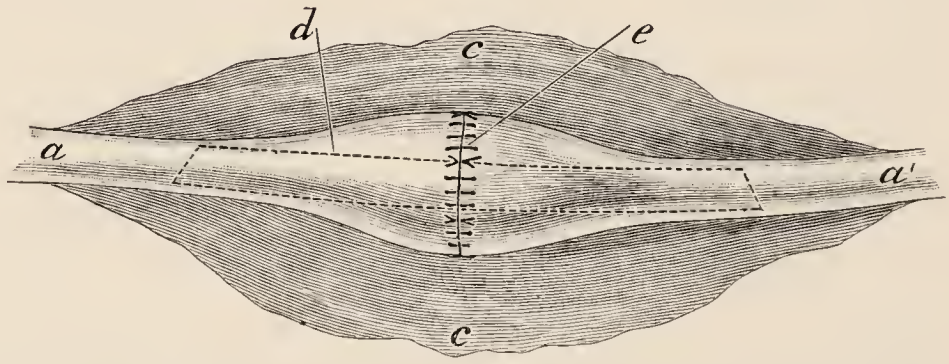



FIG. 1028.—The operation of resection-choledochorrhaphy, Doyen's method. The hepatic (*a*) and duodenal (*a'*) end of duct. The duct flaps (*d*) turned over tube and united (*e*). The flaps of peritoneal and near-by connective tissues (*c*, *c*).

*The Remarks.*—This surgical attempt is cited more because of the novelty than the practicability of the endeavor. The absence of any provision for the removal of the tube and the probable opportunity to implant the hepatic end (Fig. 1023) into the intestine, followed by closure of the duodenal end, offers a rational escape from the dilemma without entertaining a serious consideration of the former plan.

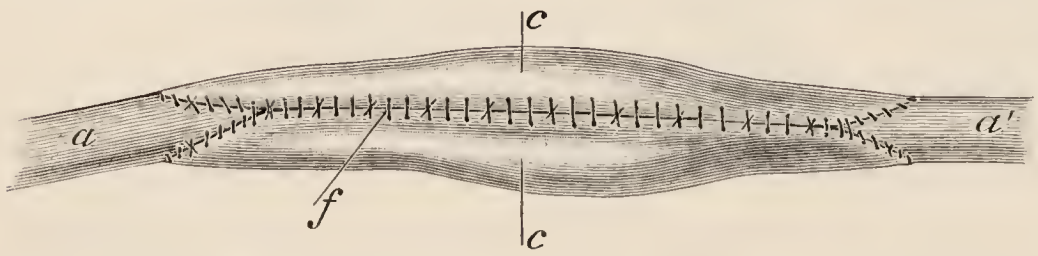



FIG. 1029.—The operation of resection-choledochorraphy, Doyen's method. The hepatic (*a*) and duodenal (*a'*) end of duct. The flaps (*c*, *c*) of peritoneal and near-by connective tissues united together and to the tube (*f*).

*The Results.* — Doyen's patient succumbed on the second day. Bile had passed along the tube and no evidence of inflammation was present on autopsy.

*Reynier* operated successfully on a dog by this method.

**Resection of the Border of the Thorax.**—If, in connection with laparotomy for abdominal wounds, in exceptional cases, in operation on the hepatic ducts, and in exploration of the liver, the space is too limited for suitable manipulation and wise operative practice, resection of the costal cartilages may be performed (Figs. 1030 and 1031). In thoracico-abdominal wounds the transpleuro-peritoneal route may be combined with the abdominal (*c*). The forcible drawing upward of the liver, along with the costal border of the thorax, together with the support gained by the passage of the finger through the foramen of Winslow, will increase markedly the opportunities

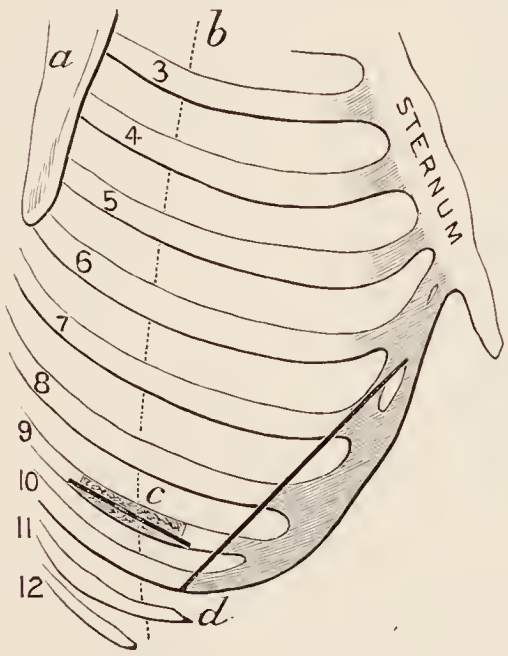



FIG. 1030.—The resection of costal border. *a*. Scapula. *b*. Axillary line. *c*. Transpleuro-peritoneal route. *d*. Incision for resection of costal margin.

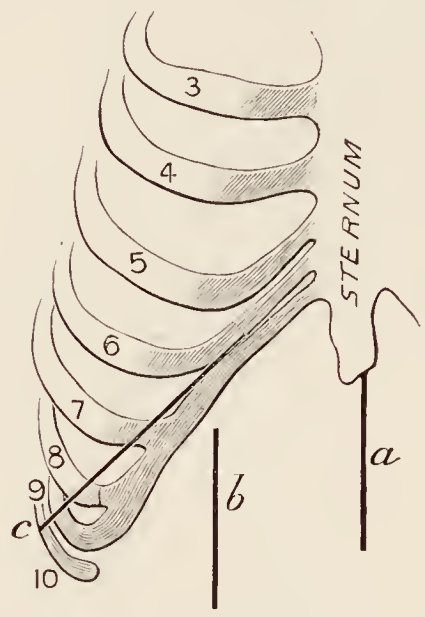



FIG. 1031.—The resection of costal border. *a*. Median line incision. *b*. Incision in right linea semilunaris. *c*. Incision for resection of costal margin.

for action in gall-duct surgery. The location of the incision and the extent of the costal resection are decided by the site of the wound or of the disease and the needs of explorative examination. After separation of the diaphragm and transversalis muscles from the costal border, it is resected and turned to suit the convenience of the operator. *Lange* regards resection as indicated in operations for gallstones where the liver is very small and located high up behind the ribs, also where the liver is enlarged, especially in fat persons and those of compact build, to facilitate access to the common and cystic ducts. In a successful case, after resection it was necessary to draw upward through the wound about a third of the liver before he could safely remove the calculus. *Halsted* speaks highly of the aid which resection of the cartilages often affords in operations on the bile ducts.

**Biliary Fistula.**—Biliary fistula not infrequently is a troublesome sequel of cholecystostomy, dependent usually on obstruction of the common duct, due to calculus and to malignant disease of the head of the pancreas. If from the former cause, the obstacle should be removed through a free incision by one of the various measures directed to the purpose. Failing in this, cholecyst-enterostomy, or implantation of the hepatic end of the duct into the intestine, may be considered. If from the latter cause, cholecyst-enterostomy offers the best solution of the problem (page 811).

## OPERATIONS ON THE KIDNEYS.

*The Anatomical Points.*—A horizontal line corresponding in front to the umbilicus is below the lower edge of the kidney. Therefore, when the kidney extends below this line, it is either of abnormal length or is displaced downward. A vertical line, extending from the middle of Poupart's ligament to the ribs, crosses the kidney in its long axis, one third of the kidney lying to the outer and two thirds to the inner side of the line. The outer border of the erector spinæ muscle may be regarded as the superficial guide to the kidney and the quadratus lumborum muscle the deep guide, the kidney lying in front of the latter (Figs. 1032 and 1033). A line drawn from the spinous process of the eleventh dorsal vertebræ horizontally outward marks the site of the upper end of the left kidney, and a point two inches above the crest of the ilium of the same side indicates the site of the lower end. The right kidney is about half to three quarters of an inch lower than the left. The hilum lies at a point located about two inches from the median line of the back, and on a level with the spinous process of the first lumbar vertebra. It follows, therefore, that the eleventh and twelfth ribs—more especially the latter—intervene between the upper part of the kidney and the external world. Hence these ribs—particularly their anterior extremities—may be taken as the direct guide to manipulation of the upper part of the kidney, by pressure made directly backward from the front. Parts of the duodenum and colon lie in front of the right kidney, and the upper end is subperitoneal. The stomach overlies the upper, the pancreas the middle, and the colon part of the lower portion of the left kidney. The upper portion, and mainly the lower, are covered with peritonæum, but the middle not at all. The renal arteries lie in front of the associate veins more often than is usually depicted. Double renal veins are more frequent than are double renal arteries. A branch of the renal artery or vein runs across the back of the renal pelvis, and small branches of the renal artery that anastomose with the lumbar vessels are close at hand. These vessels may be wounded in ligature of the pedicle.

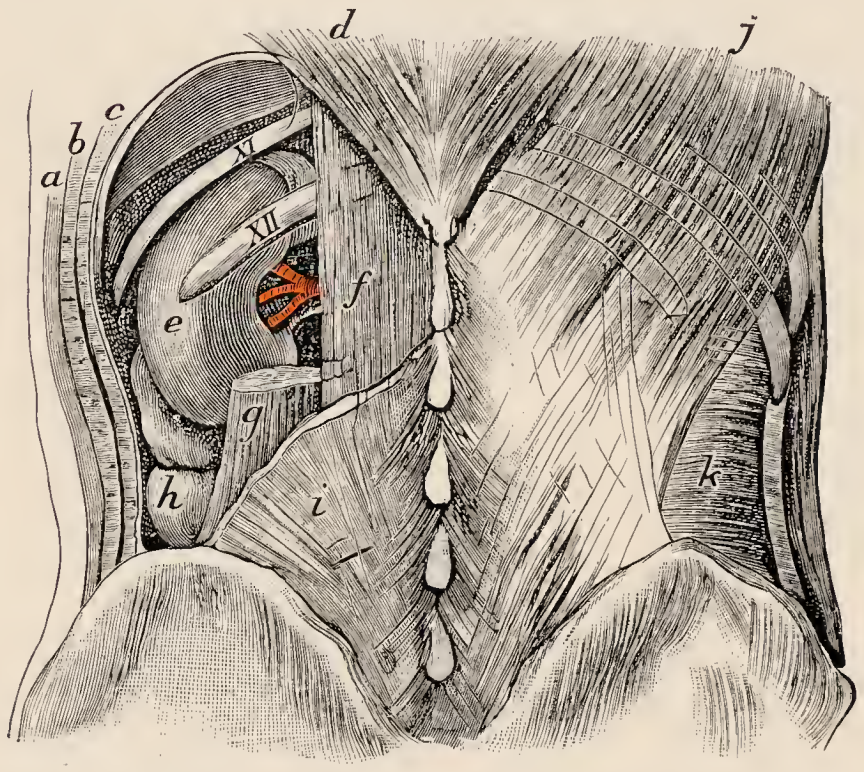



FIG. 1032.—The surgical anatomy of the left kidney. *a*. External oblique muscle. *b*. Internal oblique muscle. *c*. Transversalis muscle. *d*. Trapezius muscle. *e*. Kidney. *f*. Erector spinæ muscle. *g*. Quadratus lumborum muscle. *h*. Descending colon. *i*. Fascia lumborum, anterior layer. *j*. Latissimus dorsi muscle. *k*. Transversalis muscle.

After the tenth year, and seldom before this time, the kidney is surrounded by a fatty capsule the thickness of which is proportionate to the

degree of adiposity of the patient (Figs. 1033 and 1034). *Holl* and *Lange* have emphasized the importance of the relations of the twelfth rib and pleura in operations on the kidney in no uncertain manner. Normally the lower limit of the pleura corresponds to a line extending between the lower borders of the twelfth dorsal vertebra and the eleventh rib. The twelfth rib may be absent, or so rudimentary as to escape notice, therefore the eleventh may be mistaken for it, with obvious outcome in extended operative procedure directed to the supposed twelfth rib. When this rib is rudimentary the pleura descends as low as when of normal length.

*Melsome* has pointed out the fact that when the twelfth rib extends beyond the outer border of the erector spinæ muscle an incision reaching to the angle of the crossing does not endanger the pleura except when the muscle is cut into or pulled aside, thus changing, perhaps needlessly, the normal relations of the parts. However, in the absence of this rib, or its failure to cross the muscle, the trusty angle is not present, but instead a deceptive one is formed higher up by the eleventh instead of the twelfth rib.

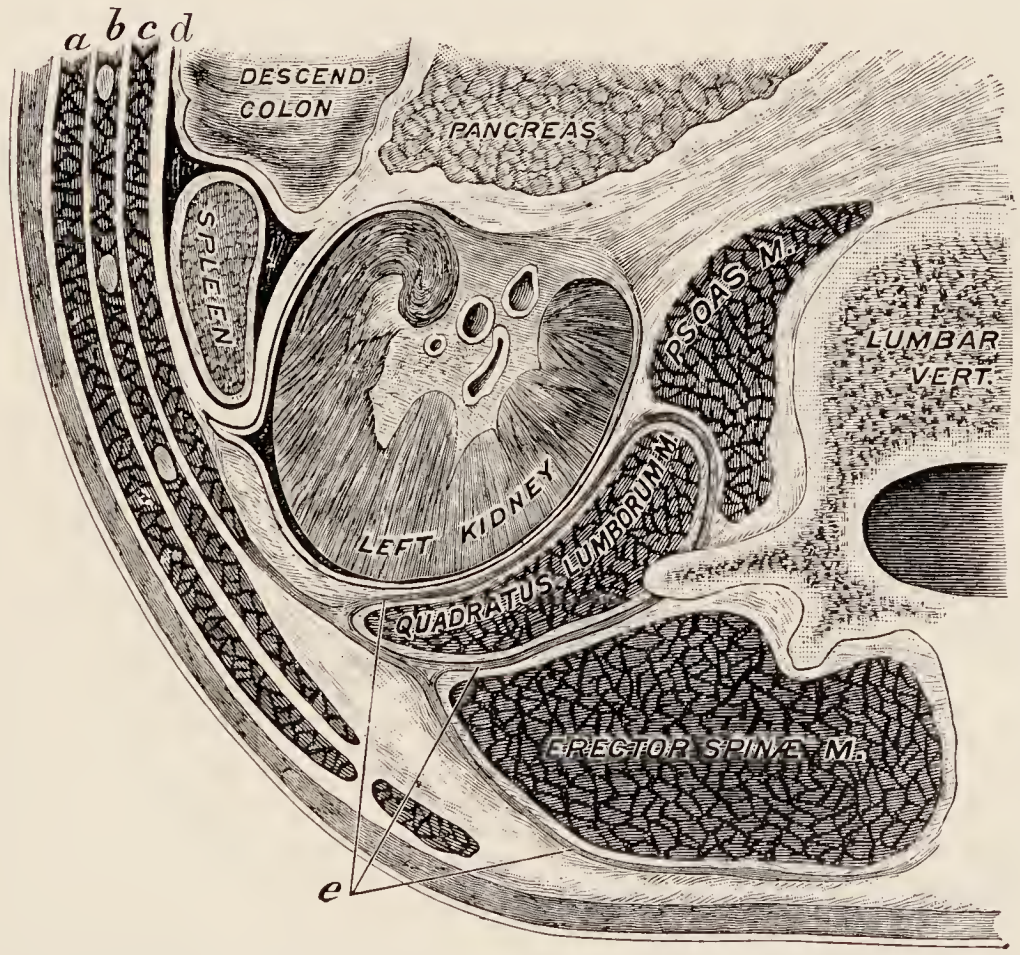



FIG. 1033.—The surgical anatomy of the left kidney, transverse section. *a*. External oblique muscle. *b*. Internal oblique muscle. *c*. Transversalis muscle. *d*. Fascia transversalis and peritonæum. *e*. Anterior, middle, and posterior of lumbar fascia.

If this fallacy be not determined by previous counting of the ribs, from above downward, the pleural cavity is almost certain to be invaded. But laterally, on the left the pleura extends to within an inch and a half of the costal margin; on the right to within two inches.

**Nephropexy.**—Nephropexy (nephrorrhaphy) is an operation directed to the fixation of a troublesome movable or floating kidney. The former condition is quite common and usually acquired; the latter is rare and congenital. The right kidney is mobile much more frequently than the left; both may be similarly affected together, the left rarely alone.

*The Operation.*—Place the patient with the sound side resting on a hard pillow so as to make the field of operation convex and to increase the distance between the last rib and the crest of the ilium (Figs. 1036 and 1037); locate the twelfth rib and half an inch below at the outer border of the erector spinæ begin the incision (Figs. 1043, perpendicular *C*, 1032, and 1033); carry the incision downward along the outer border of the sheath of this muscle, which should not be opened, toward the iliac crest for three or four inches; divide the superficial tissues down to the posterior border of the latissimus dorsi (Figs. 1032 and 1033); draw forward the fibers of this muscle and divide

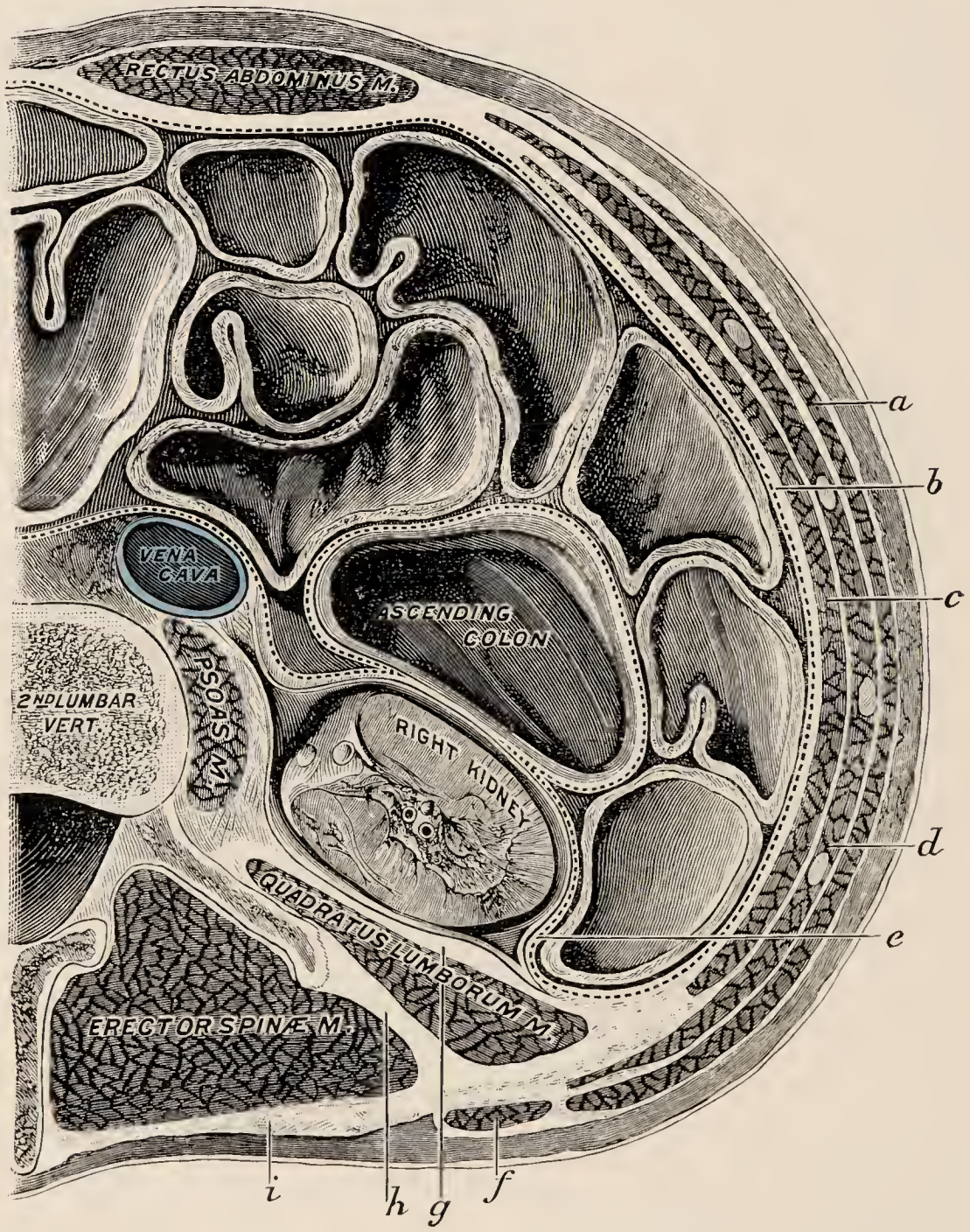



FIG. 1034.—The surgical anatomy of the right kidney, transverse section. *a*. External oblique muscle. *b*. Peritonæum. *c*. Transversalis muscle. *d*. Internal oblique muscle. *e*. Peritonæum. *f*. Latissimus dorsi muscle. *g*. Anterior layer of lumbar fascia. *h*. Middle layer of lumbar fascia lying above transversalis fascia. *i*. Posterior layer of lumbar fascia.

the lumbar aponeurosis connected with the internal oblique and transversalis muscles down to the quadratus lumborum; ligature the lumbar arteries; push aside or divide, as necessary, the outer border of the quadratus lumborum muscle; cut through the anterior lamella of the lumbar fascia and expose the fascia transversalis (Fig. 1034); divide this fascia, and thus expose to view the fatty capsule of the kidney; draw apart the borders of all the divided




FIG. 1035.—Instruments employed in operations on the kidney.

*a*. Retractor, exploring needle, probe, grooved director, and tenotome, employed in searching for calculi. *c*. Blunt hook and tenaculum. *d*. Periosteotome. *e*. Blunt dissector. *f* and *h*. Forceps for removal of stone. *i*, *j*, and *k*. Variously formed scoops. *l*. Kangaroo tendon in glass tube. *m*. Costotome for cutting cartilages and ribs. *n*. Curved and straight pedicle clamps. *o*. Long-bladed clamp. *p*. Searcher for stone. *q* and *r*. Direct, adjustable (Polk's), and curved ligature carriers for tying pedicle. *s*. Curved and straight needles. *t* and *u*. Long-bladed forceps for catching fragments of stone in pelvis and in ureter. *v*. Silkworm gut and chromicized catgut. Scalpels, bistouries, forcipressure, a needle-holder, silk, catgut, thumb and mouse-tooth forceps, long-handled scissors, large drainage tube, a spatula, and a uterine dilator should be provided.

tissues, causing the fatty capsule to project into the wound under pressure directed upward and backward by the hand of an assistant applied to the abdomen in front; insert the fingers into the wound beneath the fatty capsule and draw it and the kidney farther outward; open the fatty capsule in the long axis of the kidney; seize the borders of the divided capsule and draw them with the kidney still farther outward, thus causing the capsule to embrace the kidney snugly; from this time one of several plans of fixation can be practiced. 1. Trim away the superabundant fatty capsule, and sew the divided borders to the deep structures of the wound with kangaroo tendon or chromicized catgut. In this method the borders of the wound are approximated somewhat, and the remaining space stuffed with gauze, which is removed from time to time, with the idea of fixing the kidney in place by means of the cicatricial attachments resulting from the closure of the wound by granulation. This method can not be commended because of the low rate of success. 2. After the fatty capsule is trimmed, divide the fibrous capsule longitudinally at the outer border of the kidney for three or four inches; strip off the capsule for half an inch at either side of the entire length of the incision; pass five or six chromicized catgut or kangaroo-tendon sutures at either side, causing them to include the reflected part of the fibrous capsule, a limited portion of the unreflected part, the kidney substance for half an inch, and the border of the fatty capsule, with the transversalis fascia and the other deep tissues of the wound. Three or four sutures are carried from side to side through the transversalis and lumbar fasciæ and the superimposed deep tissues, the stripped fibrous capsule, the unstripped near to its attachment and the kidney structure for an inch or so, and tied after approximation of the borders of the main wound with suture so as to relieve the strain on the deeper ones. These sutures are drawn only sufficiently firm to approximate and hold the various structures in position while union takes place. The technique of fixation is variously modified, and is quite too extended to be presented in detail. It is sufficient, as it seems to us, to indicate that the kidney can be anchored to the borders of the abdominal wound by one of the following plans, with varying results (page 834) (Delvoie):

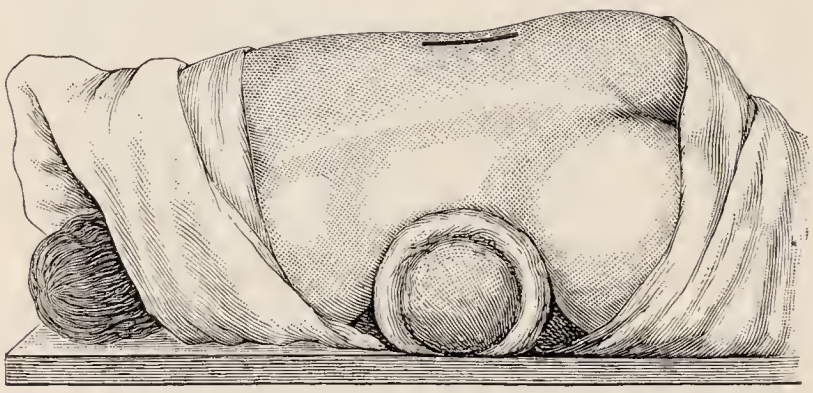


FIG. 1036.—The exposure of the kidney. Incision at outer border of erector spinæ muscle. Patient in Simon's position.

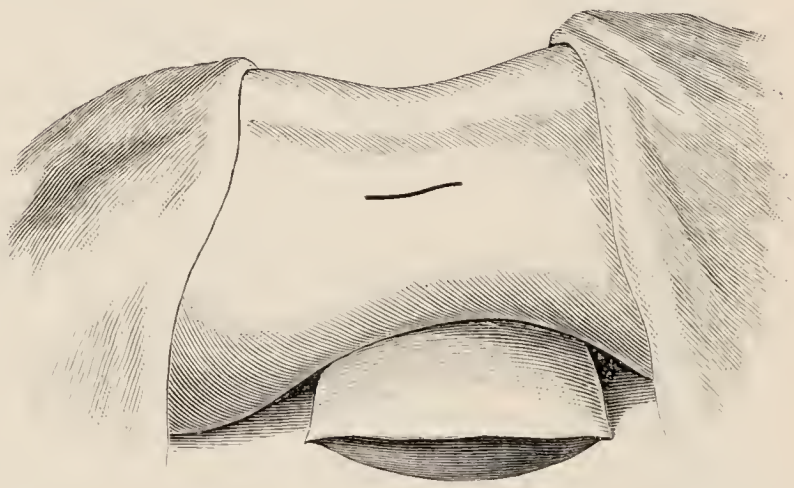


FIG. 1037.—The exposure of the kidney. Incision at outer border of erector spinæ. Patient in Lange's position.

(*a*) Suture of the fatty capsule to borders of wound.

(*b*) Suture of the fibrous capsule.

(*c*) Suture of the parenchyma without stripping of the capsule.

(*d*) Suture of the parenchyma after stripping of the capsule.

(*e*) In either instance the kidney should be pushed into the wound before fixation.

(*f*) Special methods of practice.

**Senn's Method.**—*Senn*, after exposure of the kidney through the vertical incision, divided and removed the fatty and scarified the fibrous capsule

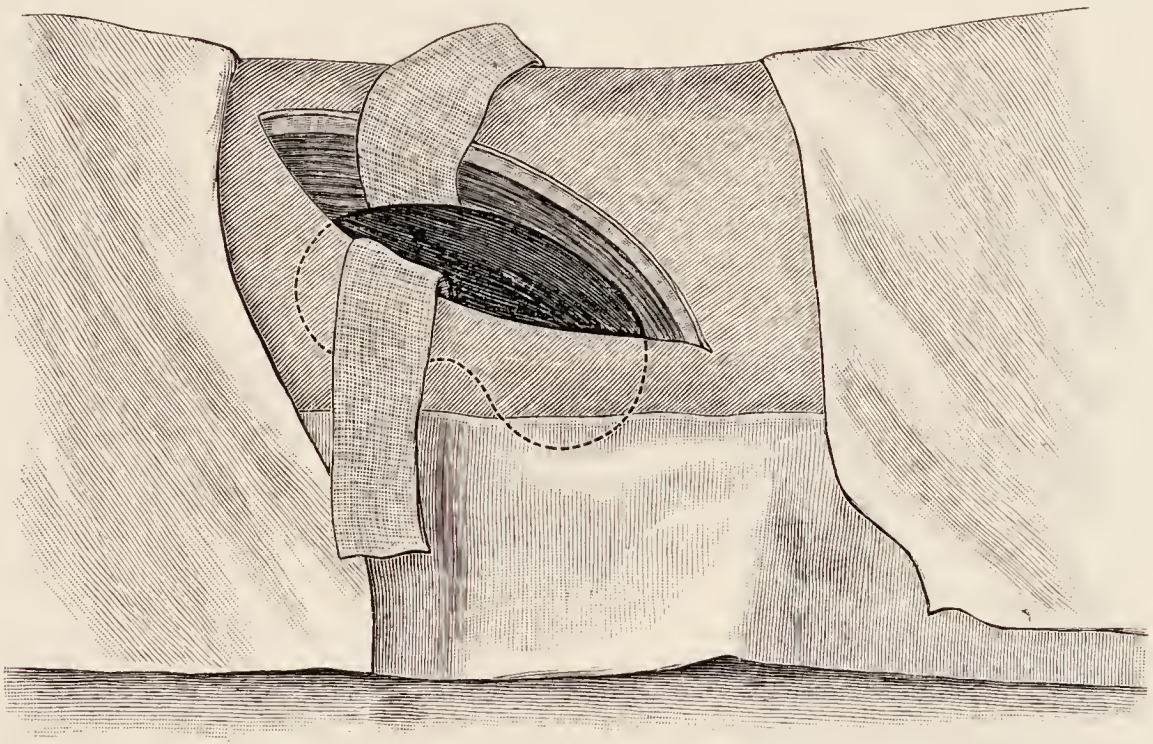


FIG. 1038.—The operation of nephropexy, Senn's method. Showing sling of gauze around upper end of kidney.

freely with cambric needles held by forceps. He passed underneath the upper extremity of the kidney a strip of iodoform gauze twelve inches long

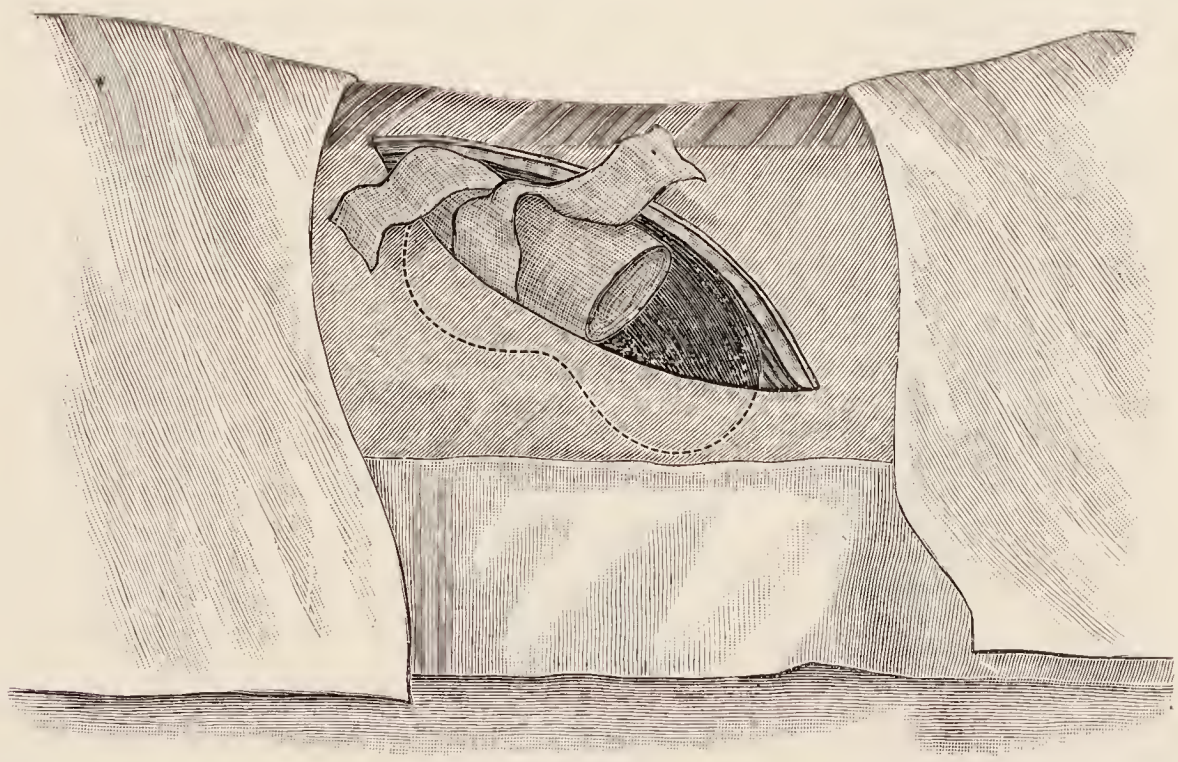


FIG. 1039.—The operation of nephropexy, Senn's method. Showing sling of gauze and pad.

and two inches wide, placing a gauze pad over the exposed portion of the kidney (Figs. 1038 and 1039), and carrying a sling of gauze around the kid-

ney, fastened it in position over the gauze pad. He introduced two sutures into the upper angle of the wound, leaving them untied. He then packed around and beneath the kidney abundant gauze, and placed and bound in position over the right hypochondrium a pad of sufficient dimensions to reenforce the gauze supports.

The wound was redressed in three days and the secondary sutures tied. The packing beneath the kidney was removed in six days after the operation, and the gauze sling in eleven, exposing to view in each instance freely granulating surfaces, which were maintained in contact with each other by means of adhesive strips carried around the body, and which at the same time narrowed the external wound. In this operation the patients should be kept in the recumbent posture until the adhesions become substantially organized. The claims made by Senn in support of this method of practice are certainly rational and prudent. He says: "1. An extrarenal support of the kidney is obtained. 2. This support is formed by union of the fibrous capsule of the kidney with the pararenal connective tissue; hence no interference with the kidney itself. 3. The gauze sling draws the lower pole of the kidney in an outward direction, placing the axis of the kidney at an oblique angle. This position secures support from the parietal wall at the lower angle of the wound, and favors correction of flexion of the ureter, provided it be present." If the kidney is not held in proper position by the gauze sling, as illustrated, it should be carried around the lower instead of the upper part of the kidney.

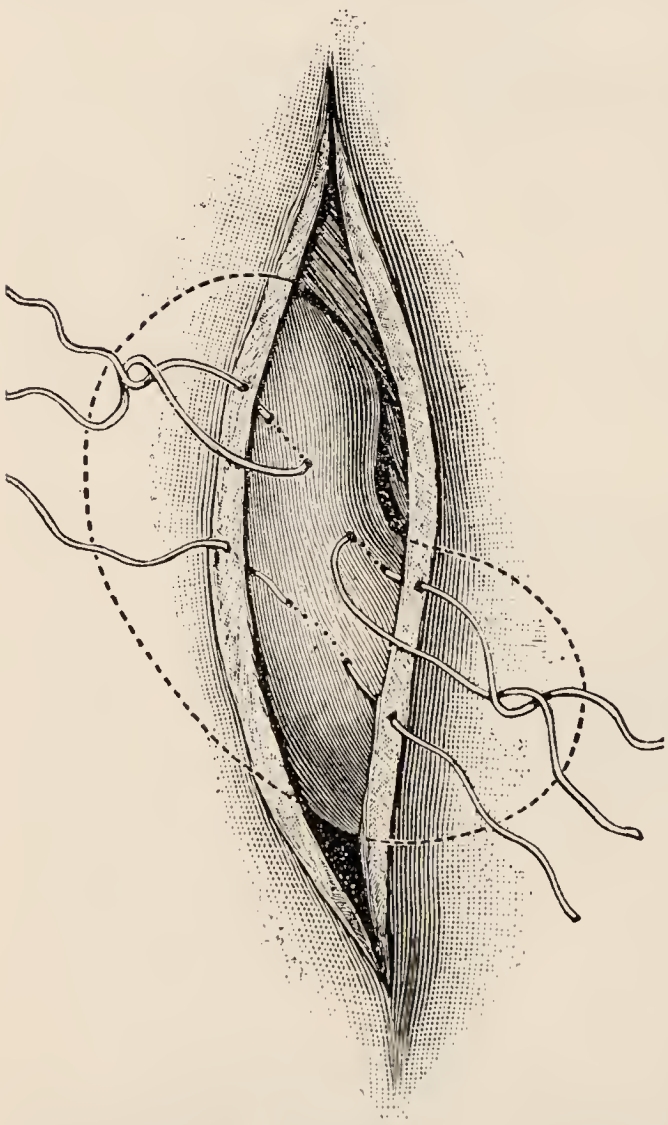


Fig. 1040.—The operation of nephropexy, Morris's method.

*Deaver* removes the fatty capsule entirely from the posterior surface and to the hilum from the anterior. He passes gauze beneath the upper pole of the kidney and below the lower, allowing it to remain in place for a week or ten days. Gauze is packed around the kidney and the hypogastric compress employed as in the preceding instance. Usually the wound heals completely in four or five weeks.

**Morris's Method.**—*Henry Morris* fixes the kidney in the wound by means of three silk sutures passed through the fibrous capsule and kidney substance and the borders of the transverse fascia and aponeurosis of the transversalis muscle and tied, as indicated in the illustration (Fig. 1040). The wound is closed at once and the patient kept quiet in bed for three or four weeks. Morris has practiced this plan satisfactorily for many years, and consequently commends it highly. Strict asepsis should be practiced, otherwise the silk sutures will become troublesome.

*Tauffer*, objecting to the introduction of sutures into the kidney, "because of their ill effects," advised limited decortication, with the view of securing union of the exposed kidney structure to the abdominal wound, aided by stitching the reflected flaps to the fascial and aponeurotic tissues. Modifications in the size, extent, shape, and attachments of the flaps have been practiced by different operators, but as yet a decided opinion regarding their comparative worth can not be expressed.

*Vulliet*, after exposing and lifting the kidney in the usual manner, raises, through a short vertical incision of the skin and fascia, made parallel with the spinous process of the first lumbar vertebra, a slip of the tendon of the erector spinæ, about ten inches long and a quarter of an inch wide, which is then divided above, pulled out through the primary wound, and left attached below. The slip is then carried through the muscle, caused to underrun the fibrous capsule of the kidney, thence is passed backward and attached to the muscle above (Fig. 1041). *Morris* divides the slip into upper and lower portions, and passes one beneath the capsule, tying the end to the remaining part.

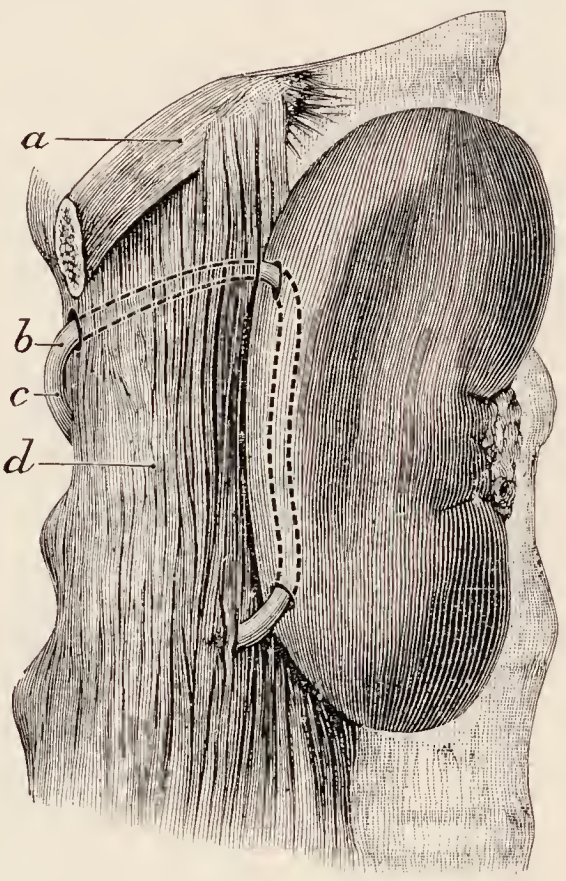



FIG. 1041.—The operation of nephropexy, Vulliet's method.

*Franks*, noting the fact that the kidney, when hardened in position, is grooved by the twelfth rib, advises anchoring the organ to that bone. Therefore the capsule is divided and reflected briefly at the place on the surface where it is proposed to pass the sutures. The flaps and the exposed kidney substance are then sutured to the twelfth rib with catgut. The patient is kept in bed for six weeks.

After fixation is completed the sutures are cut short, the deep tissues of the wound united with buried catgut sutures and the superficial closed with silkworm gut, leaving, if desired, proper space for the introduction of deep drainage. The usual aseptic dressings are applied to the wound, and a firm compress is so placed in front as to maintain the kidney in proper relation with the wound on application of the abdominal binder.

The incision for reaching the kidney in this operation is obliquely placed by many surgeons (Fig. 1042, *a*), the obliquity being modified by the need for room. The oblique incision as commonly practiced is begun an inch below the twelfth rib at the outer border of the erector spinæ, and is carried obliquely downward and forward so as to expose the anterior border of the latissimus dorsi, and the posterior border of the external oblique. It will be seen that the lumbar aponeurosis is divided farther outward in this incision than in the vertical one, and that the quadratus lumborum is reached nearer to its outer border (Figs. 1033 and 1043). In other respects no practical difference exists. In stout patients it may be advisable to make a T-shaped

incision, to afford more room and better observation. The horizontal part of this incision should be securely closed at once, irrespective of the treatment of the remaining portion.

*The kidney can be readily exposed* for diagnostic and other purposes without dividing the muscles, nerves, or vessels by means of the "gridiron" manner of dissection employed in operation for appendicitis. Begin the incision at the inner side of the anterior superior spine of the ilium, and carry it obliquely backward and upward toward the tip of the last rib; split correspondingly the fibers and aponeuroses of the external oblique muscle, and draw the borders well apart; split the fibers of the internal oblique in a line extending between the ninth costal cartilage and the posterior superior spinous process of the ilium, and retract the borders, thus exposing the fibers of the transversalis muscle; split and draw apart the fibers of the transversalis, incise the transversalis fascia, exposing the subserous tissue and perirenal fat; pass the fingers through the fat, expose and raise the kidney into the wound, and anchor it.

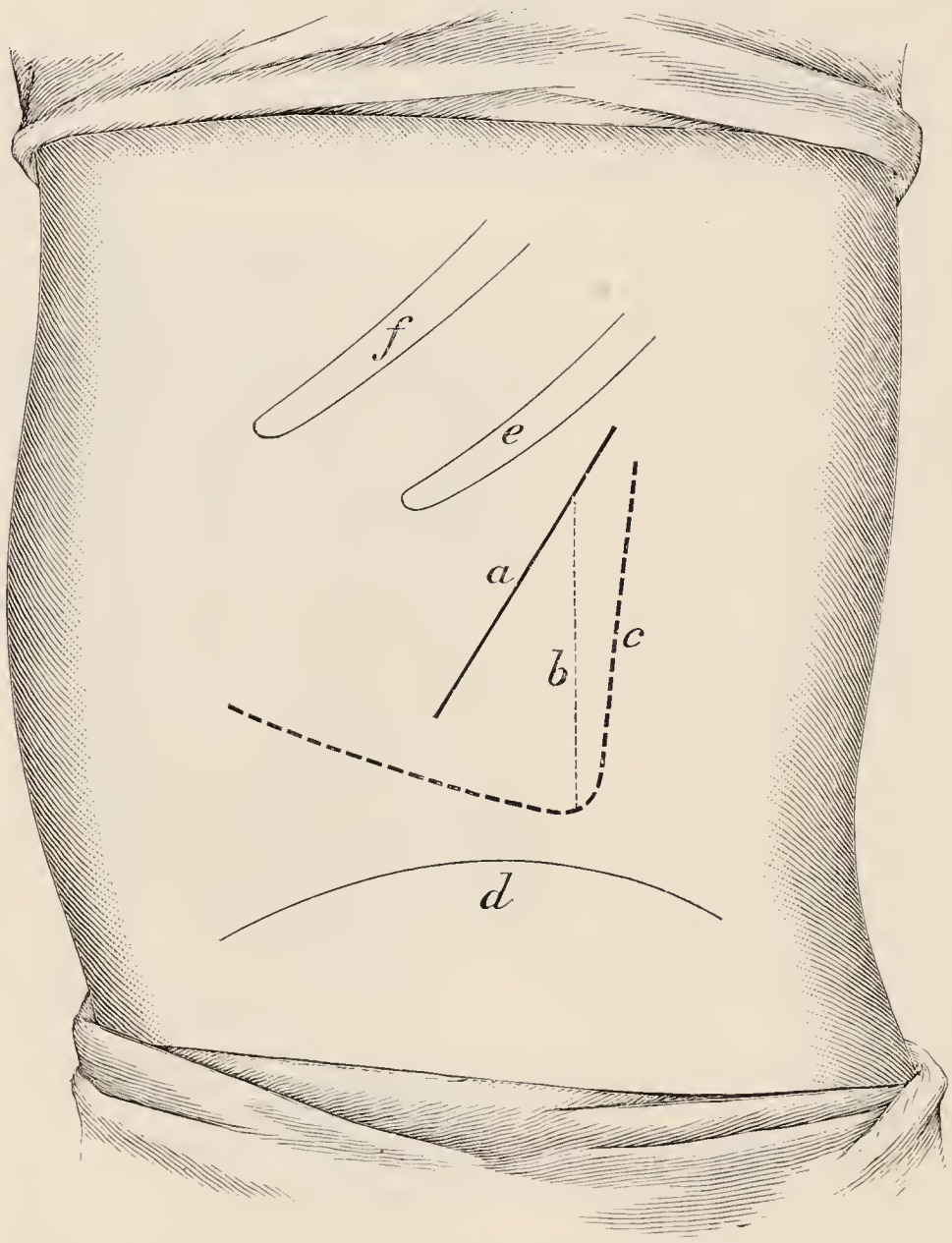



FIG. 1042.—The linear guides for operations on the kidney. *a*. Lines for incision in exploration in nethrotomy and in nephrolithotomy. *b*. Morris's secondary incision in nephrectomy. *c*. König's lumbo-abdominal incision in nephrectomy. *d*. Outline of iliac crest. *f*. Eleventh rib. *e*. Twelfth rib.

*Robson* commends this method of approach as being useful for divers purposes directed to the kidney. Time in operation is saved, no blood is lost, rapid and secure repair follows, and the procedure does not incur special danger nor assume the lay significance of free incision.

*The Precautions.*—Carefully note the presence of the twelfth rib, and as carefully approach the upper end of the kidney in operation, fearing involvement of the pleural and peritoneal cavities. Recognition of the anterior lamella of the lumbar fascia and of the fascia transversalis (Figs. 1033 and 1034) will prevent premature search for the kidney, and may obviate delay

and even defeat in finding it; it may also prevent a precipitate and perhaps unnecessary involvement of the peritoneal cavity. If the kidney be pushed too far upward before fixation, the downward movement of the liver, with breathing, will hinder proper union. In fact, profound inspiration should be interdicted for a time for a similar reason. A freely movable and a floating kidney should be approached with care to avoid unnecessary or unexpected invasion of the peritoneal cavity. If the fatty capsule is thin, a mesonephron is present, and involvement of the peritoneal cavity by tearing of the peritonæum is liable to happen, especially if undue vigor is used in traction or other manipulations. These tears should be closed at once by sewing or ligature, depending upon the size and situation.

*The Remarks.*—Deep drainage should be employed when infection of the wound is suspected. Deep drainage is advised by some surgeons in all instances on account of the irritating effect on the tissues of its presence, thereby securing firmer union. However, this desideratum may be reached instead by a free scratching of the tissues before closure of the wound. The sutures involving the kidney structure are employed for the purpose of approximation, not of union of the included structures, for if drawn tightly the kidney tissue is promptly cut through. The removal of the posterior part of the fatty capsule is advised by some, in order to place the subjacent part of the kidney directly in contact with muscular tissue. Needles with sharp borders and silkworm gut ought not to be introduced into the kidney. The deeper dissections are conducted more safely by means of blunt scissors. *Edebohls* secures ready access to the kidney by placing between the belly of the patient and the table an air-distended rubber cylinder nine inches in diameter.

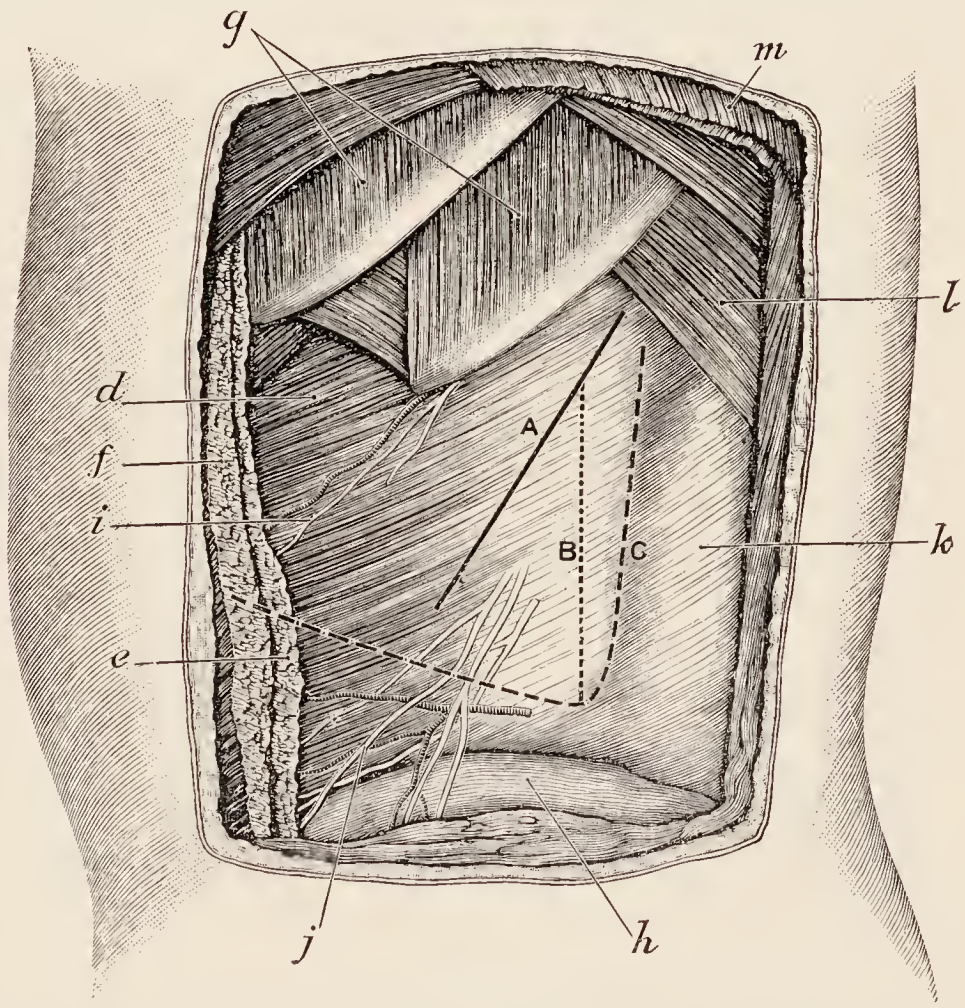



FIG. 1043.—The anatomy of incisions in operations on the kidney. *A*. Lines of incisions in exploration of kidney in nephropexy, nephrectomy, and nephrolithotomy. *B*. Morris's secondary incision in nephrectomy. *C*. König's lumbo-abdominal incision in nephrectomy. *d*. Transversalis muscle. *e*. Internal oblique muscle. *f*. External oblique muscle. *g*. Intercostal muscles. *h*. Crest of ilium. *i*. Intercostal nerve and artery. *j*. Twelfth dorsal nerve and lumbar artery. *k*. Fascia lumborum, erector spinæ beneath. *l*. Serratus posticus major muscle. *m*. Latissimus dorsi muscle.

After division of the fatty capsule the patient is pulled down so that the chest rests on the rubber cushion, causing the respiratory movements of the diaphragm to force the kidney through the opening.

*The after-treatment* consists in keeping the patient quiet in the recumbent posture for three or four weeks. The drainage tube may be retained for some time with the view of stimulating firm repair. The contents of the bowels are kept in a soluble condition. The wearing of a body band and the avoiding of severe strain should be carefully practiced for some months.

*The Results.*—The results are modified very largely, indeed, by the plan of procedure practiced by the surgeon. The following statistics of *Delvoie*, relating to two hundred and fifteen cases, are exceedingly instructive, and do much to settle the best methods of procedure:

| | No. cases. | Cures. | Improved. | Unsuccessful. | Relapse. | Deaths. |
|---|---|---|---|---|---|---|
| Suture of the fatty capsule..... | 14 | 4 | 3 | 2 | 5 | 0 |
| Suture of the fibrous capsule.... | 24 | 10 | 3 | 4 | 5 | 2 |
| Suture of the parenchyma without stripping of the capsule... | 110 | 75 | 14 | 11 | 8 | 2 |
| Suture of the parenchyma after stripping the capsule..... | 10 | 9 | 0 | 1 | 0 | 0 |
| Special methods..... | 10 | 5 | 5 | 0 | 0 | 0 |
| Operative procedures of uncertain character..... | 47 | 32 | 5 | 7 | 2 | 1 |
| | 215 | 135 | 30 | 25 | 20 | 5 |

The general death rate is from 2 to 4 per cent when the operation is practiced under favorable auspices. According to Albarran, in 374 cases 7 died within four months of operation, of which deaths 4 could be attributed properly to the operative procedure alone. In 88 per cent of these cases pain was cured; in 14 per cent nervous symptoms were partially cured, but in 36 per cent no benefit was experienced in this regard. *Edebohls* reports 1 death in 50 cases with but 2 relapses in six years. *Morris* reports 57 cases of his own, with 57 recoveries.

**Nephrolithotomy.**—Nephrolithotomy is the operation of incision of the kidney for the removal of stone.

The special instruments needed are retractors, spatulæ, a long needle with a handle, probes, small scoops, small lithotrity forceps, dressing and polypus and lithotomy forceps (Fig. 1035, *a*, *j*, *f*, *h*).

The kidney can be exposed by means of a lumbar or an abdominal incision (Figs. 1042, 1043, and 963).

**The Lumbar Method of Operation.**—After thorough cleansing of the colon, and employment of local antiseptic measures, place the patient on the sound side and expose the kidney (Figs. 1042 and 1043, *a*) as in nephropexy (page 826). After division of the transversalis fascia expose the fatty capsule freely by wide retraction of the borders of the divided tissues; expose the kidney by dividing and pushing aside the fatty capsule; press the kidney into the wound from in front; introduce the finger between the fatty capsule and the kidney at the posterior surface, and feel for the presence of stone while counter pressure is made in front; examine the anterior surface, using firm pressure for the purpose; thrust the exploring needle (Fig. 1035, *a*) into raised or indurated areas of the kidney to determine the presence of stone. If nothing unusual

be noted on palpation, support the kidney firmly with the hand; introduce the exploring needle at the external border between the ends of the organ, passing it toward the hilum, ten or twelve times if necessary. The pelvis of the kidney can be readily explored by means of a small sound (Fig. 1035, *p*) passed into it through a narrow incision made into the calix at the lower end of the organ (Lloyd). The metal *bougie à boule* (Fig. 1507) is the better searcher for this purpose (Clarke). Failing with these means to find a stone, make an incision at the external border of the kidney (Morris), or through the thinner part near the pelvis (Jacobson), or through the wall of the pelvis itself (Thornton), through either of which examination of the pelvis can be made by the finger or an instrument. The first incision is regarded the best, since the wound heals more promptly, and therefore is less liable to form a fistula (page 839). The situation, size, shape, and compactness of the stone will determine the freedom of removal. If a stone be located in the cortical tissue, it should be removed through an opening made directly down upon it. If it be in the pelvis of the kidney or at the mouth of the ureter, it should be removed through the channel that leads to the discovery, if practicable, otherwise through a short incision into the pelvis at the posterior wall, made cautiously with a sharp knife. Limited incision with a narrow tenotome (Fig. 1035, *a*), followed by digital or instrumental dilatation and rupture, affords the safest means of gaining access to a stone. The stretched and ruptured tissue bleeds comparatively little and heals promptly, and the presence of the finger in the opening reduces the amount of hæmorrhage to a minimum. The stone is removed with the finger, aided by scoops, forceps (Fig. 1035, *f*, *h*, *j*), etc. If it be large, hard, or irregular, it should be broken and removed piecemeal, remembering that it is better to spoil a good specimen than to damage a kidney in endeavoring to preserve the specimen. Stones surrounded by suppurating processes are more easily removed than those that are not, and the removal should be attended with antiseptic douching. The presence of stone at the opening of the ureter or farther along in the tube should be carefully determined by the finger and probe. The removal of a stone from the opening of the ureter requires skill and patience to secure the best outcome. The parts should be thoroughly cleansed after removal of the stone, especially if purulent processes have been present. In the absence of infective kidney changes the incisions of the kidney can be closed with fine catgut and the abdominal wound closed completely in the usual manner; in their presence, however, closure of the kidney wounds should be omitted. Where infection exists the introduction of a rubber drainage tube *behind* the kidney, the closure of the soft parts around it by sewing, and the application of the usual aseptic dressings complete this stage. If the perforated end of the tube be fixed firmly in the wound by sewing, and the outer part be introduced into a convenient bottle, the urine may be entirely collected for a time, whereby soiling of the tissues will be avoided.

*The Remarks.*—The fatty capsule may be adherent, tough, or dense, thus interfering with the manipulation of the kidney. The pelvis can be examined posteriorly to advantage if the kidney be turned upward (Lange).

Wounds of the pelvis of the kidney when carefully sewed often heal quite as promptly as the denser structure. In the removal of stone through incision of the renal pelvis, exploration of the cavity with the finger should be practiced if the size of the opening will permit; if not, the opening may be enlarged or the pelvis invaginated. If sutures are not to be employed to close the wound of the pelvis, it is better that the wound be made at the anterior than at the posterior aspect, as then, with the patient lying on the back, the urine is less liable to escape (Morris). *Morris* does not regard the presence of suppuration in the pelvis as a sufficient reason for the omission of sutures for the purpose of securing union. *Fenger*, we believe wisely, holds that the presence of stone in the pelvis is an assurance of sepsis there, and warns against the employment of sutures with the view of securing primary union. Free incisions of the kidney bleed copiously though not persistently, and the flow can be quite readily controlled by sponge or gauze packing with or without hot douching. If suppurative processes have been present and hæmorrhage is severe, especially in a feeble patient, a small drainage tube should be introduced into the kidney and the surrounding cavity packed with iodoform gauze. The tube sometimes can be introduced into the kidney in other suppurative cases if extensive tissue changes be present. In a stout patient, or in the case of a large or a very high kidney, a long, deep, perhaps irregular and even high incision should be made to meet the requirements of the operation. The X ray should be employed for diagnostic purposes before operation is attempted.

*The Precautions.*—Incision of the kidney should be made vertically toward the hilum to avoid unnecessary division of the cortical structure. The exploring needle should be about two inches and a half in length; if too long, or if handled carelessly, it may puncture important vessels at the hilum. In this connection it is wise to remember that the normal kidney is from two to two and a half inches in width and rather more than an inch in thickness. Keep in mind the deviations of the pleura and its relations to the twelfth rib (page 824) so as to avoid opening the pleural cavity. Small calculi are apt to escape notice in every plan of search. Tuberculous deposits, small abscesses, isolated indurations, etc., may be mistaken for stone on palpation. If the ureter be pervious, colored fluid can be injected through it into the bladder and the fact established by examination of the urine. If the ureter be washed out thoroughly with water, then plugged above, the bladder washed, and the urine drawn some time thereafter and tested, the condition of the opposite kidney can be determined (Tiffany). The ureter should be explored to determine its patency in all instances of stone in the kidney, and in those cases in which this can not be accomplished through the cortical incision a minute longitudinal incision, made at the back of the pelvis with the point of a scalpel, should be employed for the purpose, and thereafter promptly closed by sewing. In opening into the pelvis at this situation the renal vein, or a branch of it, may be mistaken for the pelvis, with obvious result. The application of a circular ligature to the opening will readily arrest the bleeding. If a doubt arise regarding the identity of these structures, forward pressure on the ureter will cause the vein to col-

lapse, and removal of the pressure will restore the circulation. The probing of old kidney sinuses incautiously may lead to puncture of the colon. Also the peritonæum may be ruptured or punctured unavoidably, and from careless manipulation. In either instance the seat of the injury should be thoroughly cleansed and promptly closed by sewing, and especially is this course demanded if infecting agents are present. When douching fluids fail to return wholly or in part, the possibility of their escape through a tear into the peritoneal cavity should be entertained as not unlikely, and abdominal section and thorough cleansing may be demanded. The adherence in the manipulations as closely as practicable to the posterior wall of the abdomen, and in any event the approaching with care to the anterior surface of the kidney, will lessen the danger of invasion of the peritoneal cavity.

**Morris's Method of Exploration.**—Morris approaches the kidney and ureter through an oblique incision beginning in front of and an inch above the anterior superior spine of the ilium, and extending obliquely outward and backward to a point corresponding to the outer border of the erector spinæ muscle and an inch below the twelfth rib (Fig. 1044). The length and direction are modified according to requirements. If greater room be needed above, the incision is extended back over the erector spinæ (*c*, *d*), perhaps dividing its outer border, or is carried upward vertically or obliquely over the outer surface of the twelfth rib, to facilitate manipulation and subsequent removal of the bone when necessary. When either examination of the ureter or of the lower part of the kidney, or possibly the control of deep hæmorrhage, is demanded, the incision is extended farther downward in a curved manner toward Poupart's ligament, then inward, parallel to and an inch above it, as circumstances suggest (*a*, *b*). The bleeding points are caught and tied as the incision is deepened. Approach carefully and divide at first a limited portion of the transversalis fascia cautiously, avoiding the colon, which frequently bulges into the wound; draw aside the borders of the wound with broad retractors, being sure to include the colon; pass the forefinger behind the loose covering of the kidney and press the structures forward; seize and drag into the wound a portion of this covering with two pairs of long forceps, and snip the tissue between them with scissors; note the prompt

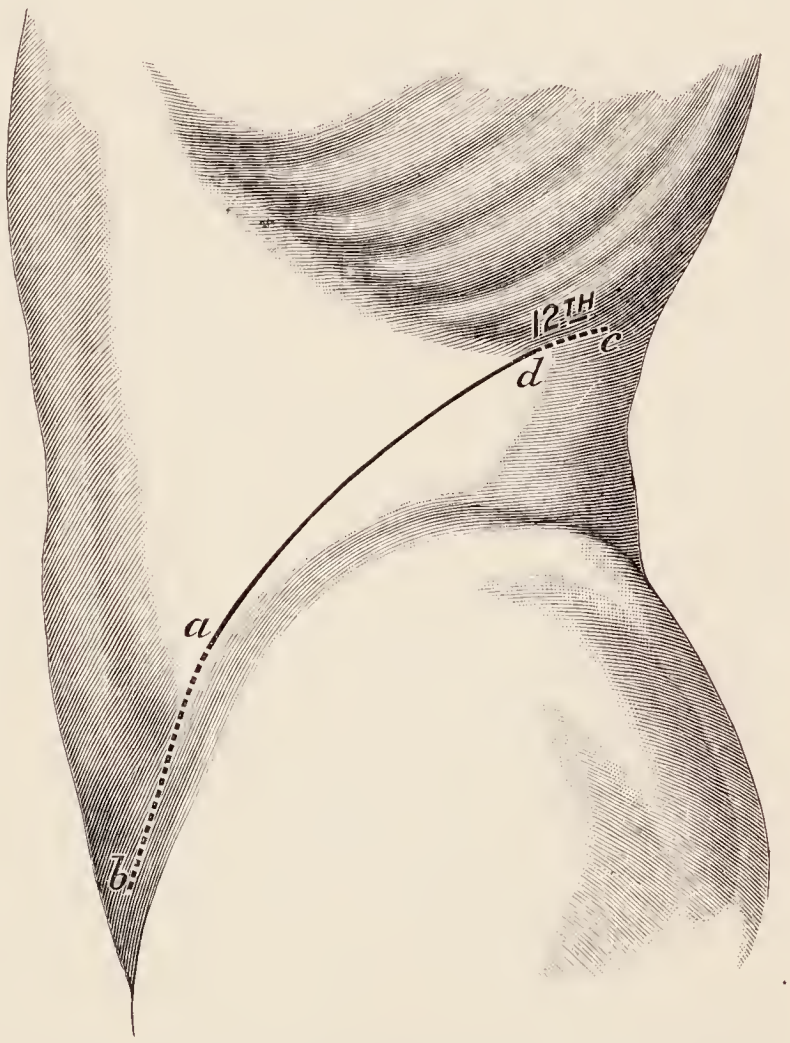



FIG. 1044.—A line of approach to the kidney and ureter, Morris's method. *a*, *d*. Primary incision. *a*, *b*, and *c*, *d*. Secondary incisions.

appearance of the fine yellow fat which closely invests the kidney; pass into the opening made by the scissors first one then the other index finger; draw aside and carefully detach the fatty tissue from the posterior surface of the kidney with the fingers; palpate the pelvis and the upper part of the ureter to detect the presence of calculi, and prevent with the finger the entrance, if possible, of any calculus into the ureter that might occur as a result of the further manipulation of the organ; free the kidney at all aspects from its fatty environment and raise it, if practicable, freely out of the wound; seize the organ with the thumb and finger so as to steady it, and compress the pedicle to control bleeding while making an incision into the kidney along the convex border; introduce through the incision into the kidney the right index finger, and examine carefully the interior for stone; remove through the opening by means of forceps any calculus that may be discovered, cautiously enlarging the opening by stretching or cutting, so as to permit the escape without needless laceration of the tissue; press upward, if possible, into the pelvis any stone lodged in the upper end of the ureter, and remove it through an incision radiating from the hilum down upon any other calculus that may be present in the sound kidney; make the incision in pouched and atrophied portions of the kidney, extending from the primary opening in the direction best intended to facilitate a prompt and secure removal of either simple, multiple, or branching calculi; explore for a second calculus through the original incision, or through another, and remove through the one best adapted for the purpose; cleanse the kidney thoroughly if infecting products be present, and introduce a drainage tube into the wound outside, but not within the kidney; unite the borders of the kidney wound with sutures if the tissues are sound; if not, sutures may be employed for the purposes of restraint, but not with the expectation of union. Morris closes the parietal wound by suture of the borders *en masse*, therefore without the aid of buried sutures.

*The Remarks.*—A fixed and rational plan of exploration of the kidney and ureter should be a part of the operative store of those who engage in the treatment of kidney disease.

**The Abdominal Explorative Method of Operation** (combined method).—In this method the explorative incision is made in front, while the stone is removed through another, and possibly shorter, incision made in the lumbar region.

*The Operation.*—Open the abdomen in the semilunar line from the margin of the ribs to a point opposite the umbilicus (Langenbüch) (Fig. 963); introduce the hand and examine both kidneys and ureters carefully for stone; press the organ into place firmly and push the colon inward if stone be found in the kidney; make an incision in the lumbar region down upon the kidney as in the preceding instance; expose and remove the stone through the loin and treat the case as before detailed.

*The Remarks.*—The ascertainment of the condition of both kidneys and ureters, and the avoidance of injury to contiguous vessels are the chief advantages of this method. However, the use of the cystoscope (page 1159) may enable one to determine the condition of both kidneys by noting the characteristics of their respective discharges into the bladder. And, too, catheterism

of the ureters (page 882 *et seq.*), especially in the female, may detect the presence of stone in the kidney. If a distended colon obstructs the way, push it aside and confine with sponges. The drainage tube should be shortened from time to time as the wound closes, and not finally removed until unaided drainage is assured. If the patient be stout, or the abdominal walls rigid, or the kidney and the contiguous tissues indurated, the difficulties of the operation are correspondingly increased. A large branching, hard calculus, or a phosphatic one that crumbles readily allowing some portions to escape observation, complicates the final recovery. If the kidney has been much disturbed by the manipulations, and especially if a subsequent examination be regarded as probable, and the condition of the other kidney permitting, nephropexy should be performed.

*The After-treatment.*—The abdominal wound is closed at once in the usual manner. To the lumbar wound in either method the local treatment is chiefly addressed. Cleanliness, proper drainage, the prevention of irritation of the skin by the escaping fluids, abundant and frequently applied absorbent dressings, constitute the principal measures in the treatment of these wounds.

*The Results.*—In nephrolithotomy the general death rate is about 14 per cent, in non-suppurative cases from 2 to 5 per cent, in the suppurative 43 per cent. *Morris* reports 34 personal operations with 33 recoveries. *Ransohoff* reports 44 operations with failure to find stone, in none of which did death occur, and many were cured. Also that sinus follows pelvic incisions of the kidney about seven times more frequently than when the incision is made at the outer border.

**Nephrotomy.**—Nephrotomy consists in cutting into the kidney a greater or lesser depth for the removal of calculi, tumors, fluid accumulation, and for the relief of nephralgia, etc.

*The Operation.*—Place the patient as for nephrolithotomy; make the lumbar incision (Figs. 1042, 1043) as in this operation in the absence of redness and fluctuation. If either be present, make the incision at the site of the most pronounced redness or fluctuation. Expose the kidney and explore suspicious points found at any aspect of the organ with a grooved needle; incise with a knife and remove with the finger or a scoop pus collections, examining carefully for calculi and communicating abscesses; flush the kidney with a hot antiseptic solution; introduce a rubber drainage tube as far as, and sometimes into the kidney, if extensive disease be present; close the external opening around the tube by sewing and fasten the tube in place; wash the wound through the tube frequently with antiseptic fluid and shorten the tube as healing progresses. If the operation be for hydatid or other cysts, hydronephrosis, pyonephrosis, etc., the incision is made at the usual site, and, as the dissection advances, notable thinning of the respective structures is seen to have taken place, the fatty portion particularly being much condensed and thinned, and perhaps adherent in places to the kidney. Especially is this true if much distention has occurred. If a cyst be present, expose the sac, make a small incision into it with a knife or empty it by aspiration; grasp with forceps and draw outward the relaxing borders of the

sac and sew them to the deep tissues of the abdominal wound or, if possible, to the cutaneous borders; examine the cyst cavity with the finger for contiguous cysts; introduce a large drainage tube into the wound, close the borders of the incision around it by sewing, and dress the wound as before. Cleanse the wound through the tube occasionally and apply abundant antiseptic dressing.

If pyonephrosis or hydronephrosis be encountered, due to obstruction of the ureter, the obstruction should be removed if practicable, and the wound treated as in the presence of pus from other causes. Failing in the removal of the obstruction by other operative methods, either a permanent fistula must be anticipated or the kidney removed at once.

*The Precautions.*—If the kidney be mobile, careful action is essential or the peritoneal cavity will be involved. The breaking down of partitions between contiguous cavities in the kidney should be avoided, if possible, as severe bleeding is liable to occur from the vessels in the partitions, especially in tuberculous and suppurative processes. The surface of the kidney should be examined carefully after evacuation of a perinephritic abscess for the presence of small abscesses or other circumscribed disease of the organ. Large drainage tubes and frequent cleansing are required in suppurative kidney changes to secure cleanliness and avoid sepsis. Drainage tubes should be introduced into the kidney with care, as they frequently cause pain.

*The Remarks.*—The kidney itself may form part of the walls of a large abscess in the lumbar region. If the kidney be much enlarged, the lumbar incision should be placed farther forward at the outset or carried in that direction afterward. A movable kidney should be held firmly while being opened if pus is present; if cysts only are present, this manœuvre is of less importance. In either instance a movable kidney should be anchored to the borders of the wound, to secure proper retention there during recovery and afterward.

The hæmorrhage attending incisions of the kidney can be controlled by pressure made on the pedicle of the exposed organ. Alternate superficial and deep sutures are admirably adapted to secure closure of the incisions.

*Ransohoff* expresses the following conclusions regarding operation for renal calculus: "1. An absolute diagnosis of stone can not be made. 2. Nephrolithotomies may be divided into those of necessity and those of choice. In anuria and profuse hæmaturia delay is fatal. 3. Pyuria and microscopical hæmaturia, as indications of beginning destructive changes, are positive indications for operative exploration. 4. The oblique incision is to be preferred for the ease with which it permits the exploration of the entire kidney. 5. Acupuncture is not to be relied upon. 6. Incision should be made along the convex border and only when the circulation is controlled by digital compression. 7. Incisions into the pelvis for exploration and for removal of a stone are to be avoided. 8. Primary nephrectomy for stone should be reserved for extreme cases. 9. Primary union by suture, where possible, makes nephrolithotomy an ideal operation. 10. Tight packing of the kidney wound and perirenal space endangers the nerve supply of the colon. 11.

Nephrorrhaphy should form the closing act of every operation which has seriously disturbed the relations of the kidneys."

If acute suppression of urine follow nephrolithotomy, etc., copious intravenous saline injections are often of great service (McBurney). When there is reason to believe that the suppression is due to stone in the opposite kidney, remove the stone at once if feasible. The splitting of the capsule of the kidney, exposure, acupressure, and manipulation of the organ, *in cases of nephralgia*—when stone could not be found after the most careful search—have been followed often by prompt and surprising relief from pain. *Abbe*, *Johnson*, and others have called attention to this matter in such a marked manner as to emphasize its importance as a justifiable measure before advising removal of the kidney in intractable cases of doubtful cause.

*The Results.*—In nephrotomy the general death rate is about 20 per cent. In calculus pyelitis the death rate is about 43 per cent; hydronephrosis, 46 per cent; for other causes a much less per cent.

**Nephrectomy.**—Nephrectomy consists in the removal of the whole or a part of the kidney for cure of tumor, fistulæ, and those conditions not relieved by the preceding kidney operations. *Lumbar* and *abdominal* nephrectomy indicate the routes of entry to the kidney, *complete* and *partial* nephrectomy explain the limit of the removal of kidney substance.

Before attempting the removal of a kidney for disease, the ascertainment of the presence and condition of its fellow is manifestly important. It is estimated that in one in four thousand persons a solitary kidney is present. The knowledge gained by physical examination and the known relation of certain diseases to the kidneys, combined with catheterization of the ureters and cystoscopy, offer the means of determining the comparative condition of the organs before operation (page 882). The examination of the kidney through an abdominal incision with the hand is not an uncommon practice. The patient should be thoroughly prepared by therapeutic means and in an aseptic manner for the operation of nephrectomy.

**Lumbar Nephrectomy.**—The line of incision in this operation is varied, according to the demands of the case and the fancy of the operator. *If the kidney be but slightly enlarged* and not adherent, a single oblique incision, beginning at the outer border of the erector spinæ an inch below the last rib and going forward and downward to the iliac crest, and even curving forward above the crest, if greater room be needed, affords an admirable method of approach (Figs. 1042 and 1044). *If the kidney be of large size* and much adherent, considerable room will be needed for its removal. In this case the oblique primary incision is made first, and supplemented thereafter by either a superior, middle, or inferior transverse incision, according to the demands of the operation as based on the examination of the kidney made through the primary incision. In neither instance, however, is the peritonæum purposely involved in the incision.

*The Operation.*—Cleanse the field of operation thoroughly and place the patient so as to expose the wound to a good light; make the oblique incision already mentioned, dividing the tissues successively down to the kidney, if practicable; examine to ascertain the condition of the parts with the hand

introduced into the incision; make, if needed, the necessary supplementary transverse incision at the point best intended to facilitate the examination and removal of the organ; draw the borders of the wound well asunder and arrest hæmorrhage; with care enucleate the kidney from the fatty capsule, if advisable, by means of the finger or a blunt dissector; if not, separate the fatty capsule, together with the kidney, from the surrounding tissues; push the kidney into the wound as far as practicable by abdominal pressure, and define the pedicle; with care isolate the pedicle as much as possible; raise the kidney from

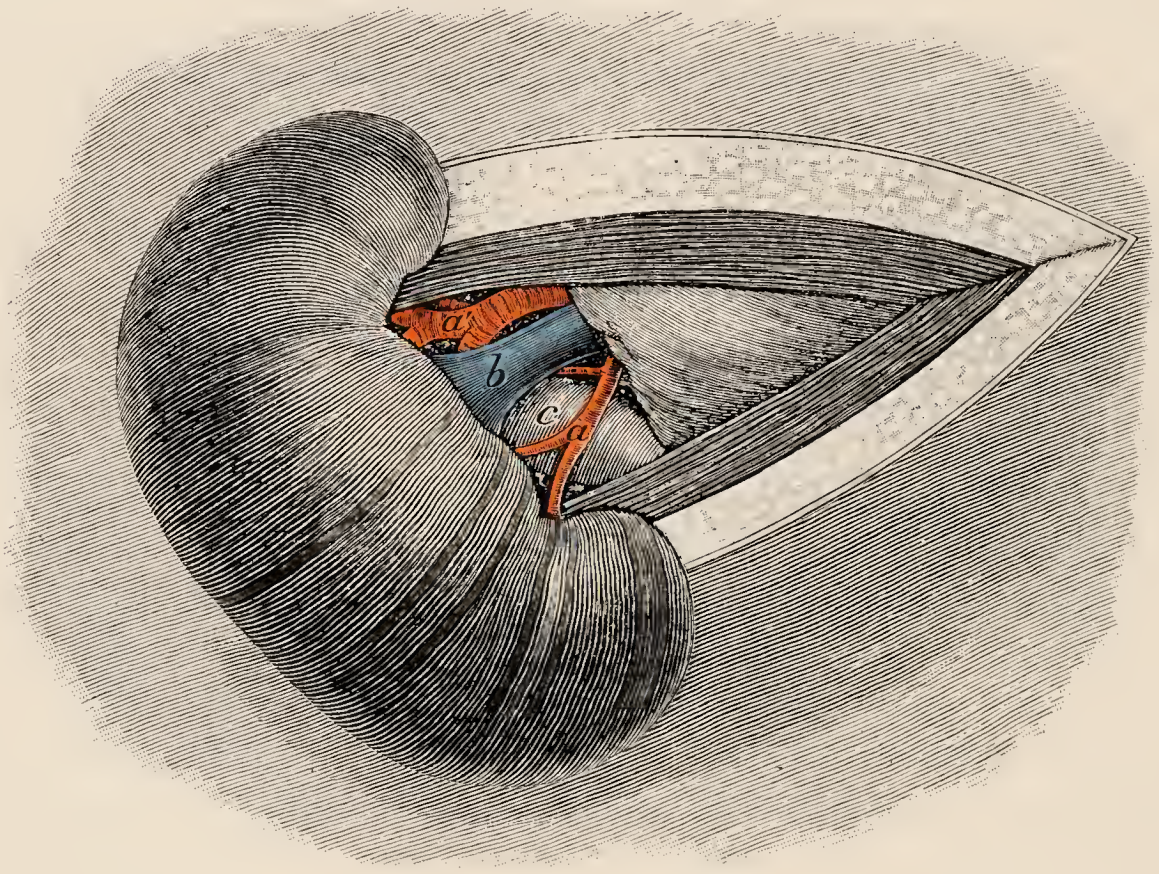



Fig. 1045.—The operation of nephrectomy, kidney lying outside. *a'*. Renal artery. *a*. Subsidiary renal artery. *b*. Renal vein. *c*. Ureter.

its bed and bring it outside the wound (Fig. 1045), if feasible, and cause it to be held steadily, without traction, by an assistant; note the pulsation of the renal artery, and with it as a guide isolate the ureter and vessels from each other; tie firmly *en masse* the vessels with a strong silk ligature carried into position by means of a large aneurism needle or ligature carrier (Fig. 1035); isolate and catch the ureter with forceps; sever the pedicle at a safe distance from the ligature with scissors; cut off the ureter and remove the kidney mass.

*The Treatment of the Ureter.*—If the ureter be much diseased it should be thoroughly cleansed, the end surrounded with gauze and brought forward and fixed in the abdominal wound with a safety pin (Thornton), or carried through an opening in the loin (Morris), or it may be isolated as low down as possible, ligatured, the extremity cauterized and returned to the abdominal cavity. If healthy, simple ligature and cauterization of the end will suffice. In the instance of tuberculous kidney the ureter may be involved, and therefore should be removed (page 868) and not returned to the abdominal cavity unless uninfected.

*The Treatment of the Pedicle.*—The vessels may be tied in two or three bundles, or, as remarked, *en masse*. The latter plan is often employed, and

the results are better than when the vessels are isolated and tied independently, as secondary hæmorrhage appears to be more commonly associated with the latter plan. A ligature applied at either side of the line of the proposed division of the pedicle is serviceable. The application of a strong clamp to the outer limit of the pedicle is highly commendable, especially when a danger of the escape of infecting products from the kidney pelvis may follow the division of the pedicle. In fact, the clamp is often employed in lieu of the ligature, and in the great majority of instances it meets satisfactorily the demands, though an occasional secondary hæmorrhage serves to admonish the surgeon of an uncertainty attending its use. It is sometimes quite impossible, at first, to form a pedicle at a safe distance from the vena cava, then a long, strong ligature is carried around the base of the growth by means of an aneurism needle and drawn tightly by the fingers or an écraseur and the kidney cut away as close to the ligature as is safe. In some instances it may be necessary to leave behind a small portion of the kidney to insure securer hold of the ligature. Incautious separation of a large growth from the vena cava may cause profuse and often fatal hæmorrhage from cutting or tearing of that vessel. If the vena cava be torn, compress the bleeding point instantly with the fingers of one hand and the aorta with those of the other; cause an assistant to compress the vena cava at the upper and lower limits of the field of operation, then remove the direct pressure from the wound of the vena cava, sponge away the blood and find the injured point; unite the divided borders of the venous wound with a continuous catgut suture (Weir). After the removal of the diseased structures by piecemeal cutting, the pedicle is secured and tied in as deliberate and efficient a manner as possible at a proper distance from the large vessels. No tension should be made on the pedicle during its ligature or division, as the proper relations of its structures would then be disturbed, and, after division is made, their consequent unequal retraction would render the ligature insecure.

**Abdominal Nephrectomy.**—The abdominal route is selected in the instances of large tumors, fat subjects, lateral deformity of the spine, those cases in which much room for examination and manipulation is required, and those that offer a minimum danger of peritoneal infection, as well as where examination of the other kidney is demanded. The initial incision may be made through the linea alba or the linea semilunaris (Langenbüch). The latter is usually selected, as it leads more directly to the kidney and ureter, and offers less exposure of the peritoneal surface to the exigencies of the operation. The late *Greig Smith* regarded an incision made through the outer fibers of the rectus muscle with especial favor, as then the fascial tissues remain intact.

*The Operation.*—Make an incision into the abdominal cavity not less than four inches in length in the line already indicated (Fig. 963), with its center opposite the navel; interpose a large, flat sponge or abundant aseptic gauze to hold aside the intestines and absorb the oozing blood; introduce the hand into the abdomen and examine carefully the condition of the kidney; shut off the peritoneal cavity from the field of operation with sponges or pads;

expose the kidney by tearing through the peritonæum where it forms the outer layer of the mesocolon (Fig. 1034, *e*), thus avoiding the nutrient vessels of the colon; separate the front of the kidney from the perirenal fat with the fingers; expose the renal vessels through the opening by drawing inward strongly the inner border of the wound with a wide hooked retractor, aided by outward displacement of the kidney; isolate the vessels with the fingers aided by a blunt dissector, and carry around them with a large aneurism needle a strong silk ligature; tie the ligature firmly, and catch the ureter with forceps; isolate the kidney completely with the fingers and sever the vessels and the ureter at safe distances from their points of constriction; raise the kidney mass from the wound, and insert sponges or gauze to arrest oozing; cleanse the wound of all escaped fluids, and arrest the bleeding points. If drainage be required, the end of the tube is caused to escape through an opening made at the loin. The peritoneal opening in the mesocolon need not be closed unless the external wound be infected, as the parts are promptly pressed into position by the intestines. The abdominal wound is closed and dressed as in other instances.

*The operation by incision through the linea alba* differs in no essential regard from that just described.

*The Precautions.*—Too vigorous or ill-directed manipulation may wound the colon as it lies upon the diseased kidney, therefore the gut should be scrutinized for the presence of such a mishap. The peritonæum covering the tumor may be torn in the efforts to isolate and remove the growth, thereby opening the way to infection of the peritoneal cavity. The separation of an extensive growth from the vena cava has but rarely caused fatal or even profuse hæmorrhage The nutrient vessels of the colon associated with the inner layer of the mesocolon should not be injured, as gangrene of the gut is liable to result. If the wound has been infected by pus, etc., during the removal of the organ, gauze packing and lumbar drainage should be utilized. A large vein lying in the outer layer of the mesocolon may be severed in going across to the kidney unless care be taken. Sometimes a large vein lies behind the kidney and ureter, that bleeds freely during separation of the tumor. A too small abdominal incision is objectionable, for it does not meet the demands of cautious exploration and manipulation.

*The Remarks.*—Plenty of room, close observation, and careful treatment of the peritonæum and pedicle are cardinal tenets of successful nephrectomy. Enucleation of the kidney from the fatty capsule is often easier to accomplish than separation of the fatty capsule from the contiguous tissues. Scissors curved on the flat are an admirable aid in enucleation of the tumor. The measures for avoiding, and for the treatment of, shock should be at hand. The ileo-costal space should be made as commodious as possible by proper flexion and well-supported inclination of the body. *König*, to secure freer access to the kidney than the ordinary incision affords, adds to the lower end of the ileo-costal, vertical, or oblique incision, an oblique extension toward the navel going often to the outer border of the rectus abdominis (Figs. 1042 and 1043). The tissues are divided down to the peritonæum, the hand is inserted into the perpendicular cut, and the peritonæum pressed forward.

Still further room can be gained by transverse division of the peritonæum, which, however, must be carefully guarded against infection, and closed as promptly as possible. Increased room for manipulation and opportunity for observation are secured by drawing upward the costal cartilages and by resection of the twelfth rib. In the event of the inability to properly control secondary hæmorrhage by ordinary measures, a firm tamponade of antiseptic gauze should be applied and confined in place for four or five days, and the removal should be conducted with extreme care to avoid a recurrent bleeding. *Mikulicz's* tampon (Fig. 1342) answers the purpose admirably; packing for forty-eight hours is quite sufficient to arrest troublesome oozing. When the colon is much raised by a marked growth the posterior layer of the mesocolon usually presents itself in the incision through the linea semilunaris. The cut edges of the peritonæum located above the seat of the kidney should be closely and finally apposed by sewing, especially when infection beneath is present or anticipated.

*The After-treatment.*—After removal of the kidney, carefully inspect the pedicle and note that all hæmorrhage is securely arrested; examine the peritonæum for rents, and close any that may be found with a continuous suture of catgut; repair the colon, if injured; cleanse the wound; arrest bleeding; introduce a large drainage tube to the bottom of the wound, along with strips of iodoform gauze if infection or oozing be anticipated; close the wound with deep sutures of chromocized catgut and superficial ones of silkworm gut; dress as usual, confining the dressing in place with a binder. Prompt union is quite common in these cases. If suppuration ensues, the usual flushing through the tube is practiced.

*The Choice of Operation.*—Briefly stated, the lumbar incision, supplemented with one or more of the secondary incisions, is suitable for all cases, except perhaps those in which adiposity or deformity of the patient seriously interferes with the approach, examination, and treatment of the pedicle, and especially with the arrest of hæmorrhage attendant thereon. In all cases the abdominal incision gives one good command of the treatment of the pedicle and ureter, and of the complicated relations of the tumor to the important structures at the median line of the body, and the opportunity to examine the other kidney. It is rare, indeed, however, that these benefits are commensurate with the evils resulting from exposure and manipulation of the peritonæum and its contents, to say nothing of the possible impairment of the circulation of the colon, the demands of secondary hæmorrhage, and suitable drainage. Expert operators can employ the anterior incisions with far greater safety than can those of ordinary attainment.

*The Results.*—As might be supposed, the death rate in abdominal nephrectomy exceeds that of the lumbar method, due in part to the presence of more extensive disease and greater danger of peritoneal infection in the latter cases. The general death rate of the abdominal method is from 40 to 50 per cent, of the lumbar from 20 to 30. The general death rate of nephrectomy for suppurative calculous disease is from 30 to 40 per cent. In special instances of personal practice rates as low as 7 to 15 per cent are reported; for hydronephrosis, 5.75 per cent.

**Partial Nephrectomy.**—The removal of only the affected part of a kidney, for cure of injuries and morbid growths, has been practiced successfully on many occasions. Instances are noted of partial nephrectomy for the removal of circumscribed malignant disease, with uneventful recovery and apparently final cure. Hardly enough knowledge is yet at hand regarding this practice to emphasize the wisdom of the procedure, except perhaps in those cases in which there is reason to believe that the remaining kidney is in need of physiological assistance. It is proper to note in this connection that *Bradford's* experiments on dogs demonstrate that excision of a portion of the kidney is followed by an aqueous increase in the urine and in direct proportion to the amount of the organ removed, also that the function of the portion of kidney remaining appears to be able to excrete a comparatively increased amount of urea.

**Extraperitoneal Nephrectomy** (abdominal incision).—Extraperitoneal removal of the kidney can be practiced in simple cases before or after entrance to the peritoneal cavity. *In the first instance* the abdominal incision is carried down only to the peritonæum, and thereafter the peritonæum is reflected from the abdominal wall around to the kidney, which is then removed in the usual manner. *In the second instance* the incision is made into the peritoneal cavity, the kidney is examined, and, if the conditions warrant its removal, the outer border of the incision through the mesocolon is sewed to the inner border of the incision through the parietal peritonæum, thus constituting substantially a subperitoneal route through which the kidney is released and removed. It is important, however, in this connection to note that valuable time and opportunities may be sacrificed not infrequently in the practice of ingenious though unwise technique.

**Puncture of the Kidney.**—Puncture (from without) of the kidney for diagnostic purposes may or may not be a dangerous procedure, depending on the care with which it is practiced and the environment of the organ as influenced by the morbid processes connected with it. According to *Morris:* "The point selected for puncturing will depend on circumstances. If there be a spot over the swelling which is thin, soft, prominent, or fluctuating, the trocar can be inserted there. A point which is not seldom indicated is midway between the umbilicus and the anterior superior spine of the ilium, or half an inch below and an inch and a half to the side of the navel. When no particular spot is suggested by the discoloration or prominence, no better place can be selected on the left side than an inch in front of the last intercostal space; but if the tumor be of the right side this is too high, as the liver will probably be traversed. If there is no indication for operating elsewhere, the best spot to select when the kidney is of the right side is halfway between the last rib and the crest of the ilium, between two and two and a half inches behind the anterior superior spine of the ilium.

"In performing the operation the operating trocar should be inserted without any previous incision of the skin. If a larger trocar be used, an incision through the integument and muscles is sometimes made before introducing the instrument. The dangers of the operation are very slight. If, however, the puncture be made too far forward and through non-adherent

peritonæum, some of the contents of the cyst might be extravasated into the peritoneal cavity on withdrawing the trocar, an accident which has proved fatal in more than one case. There is also the danger of wounding the intestine, which, as a rule, is in front of the end adherent to the tumor; and if the trocar is long and is thrust too far inward it might penetrate some important blood-vessel causing dangerous if not fatal hæmorrhage. The penetration of the thin edge of the liver with an aspirating needle, though to be avoided, is not an accident likely to be followed by any ill consequence. The instrument should not be introduced too near the ribs for fear of wounding the pleura." Puncture and drainage for hydronephrosis should be abandoned.

**Wounds of the Kidney.**—The kidney suffers from external violence not infrequently in various degrees of severity. Wounds of the cortical substance only are less dangerous than are those involving the medullary, for in the latter instance the pelvis of the kidney is apt to be involved when hæmorrhage is much more severe and urinary extravasation more common. However, if the vessels are not injured, and the urine is healthy, the outlook is favorable even when considerable extravasation of blood and urine has taken place. If the cortex alone is injured, bloody urine will not appear, and the urine will not go astray. In wounds limited to the pelvis of the kidney hæmorrhage is comparatively small and urinary extravasation quite the reverse. In these cases blood in the urine is in small quantity and seen often only at the outset, while the amount of urine passed is lessened because of its escape through the opening.

*The Operative Treatment.*—The chief indications of operative treatment in wounds of the kidney are usually directed to the injured organ, and consist in the prompt arrest of hæmorrhage, the early detection and relief of urinary extravasation, and the prevention of infection. When penetrating violence causes the wound, with involvement of the peritoneal cavity, the concomitant injuries should be sought for and dealt with as already indicated (page 667 *et seq.*), and the kidney itself treated as circumstances seem to require. But in wounds due to other varieties of violence, or to penetrating when unaccompanied with peritoneal invasion, the lumbar incision—preceded probably by aspiration—should be made the same as in exposure of the kidney for other reasons. The fact that the majority of injuries of the kidney recover without operation should not lead the surgeon to indulge in complacent procrastination until too late to wisely meet the demands of the preceding indications. And in this connection it should be recalled that primary operative practice is productive of better final results than is the secondary. Therefore, when the early symptoms point to the presence of severe or continuous bleeding of decided character, or to urinary extravasation, prompt surgical exposure of the seat of the injury should be made by enlargement of the primary wound or through a fresh incision at the loin. After exposure of the organ and evacuation of the extravasated fluids the extent of the injury can be ascertained. Bleeding points should be sought for and tied, and vigorous oozing controlled by temporary packing with gauze pending a freer exposure of the field of injury and its thorough cleansing with fluid. Large clots of blood should be removed and the sur-

faces wiped as dry as possible with gauze. The oozing surface is then exposed and the character of the injury determined. If a clean cut not involving the pelvis be noted, the cut should be closed at once by sewing with interrupted sutures (Fig. 1046). Suturing (chromicized catgut) should commence at either end, approaching the middle of the wound, as the union is completed, with coarse sutures to prevent tearing. If the pelvis is invaded and previous infecting disease is present, the pelvic cavity should be thoroughly cleansed, the wound closed as before, or by through and through sewing (Fig. 1047) with coarse sutures, or partly closed around a drainage tube already surrounded with gauze, as circumstances require. If a gunshot, contused, or lacerated wound not involving the pelvis be present, firm packing with gauze will control the oozing and leave also suitable space for drainage. If the wound involves the pelvis of the kidney, thorough cleansing, followed by packing to arrest oozing, may be all that is needful. Extensive disorganization of the kidney or destruction of the vessels calls for total nephrectomy at once. Limited disorganization may be amenable to partial nephrectomy with union by sewing, or packing and drainage only may suffice. If the capsule is intact and the kidney overdistended with fluid, incision into and thorough cleansing of the cavity are indicated. Infected wounds and those in which doubt of prompt and final repair is entertained should be drained. Healthy aseptic wounds should be closed. The present limited knowledge of the scope of operative attacks on the kidney and of the devious characteristics of its injuries, together with the limited space for expression, make it impossible to do more at this time than to present a general outline of treatment.

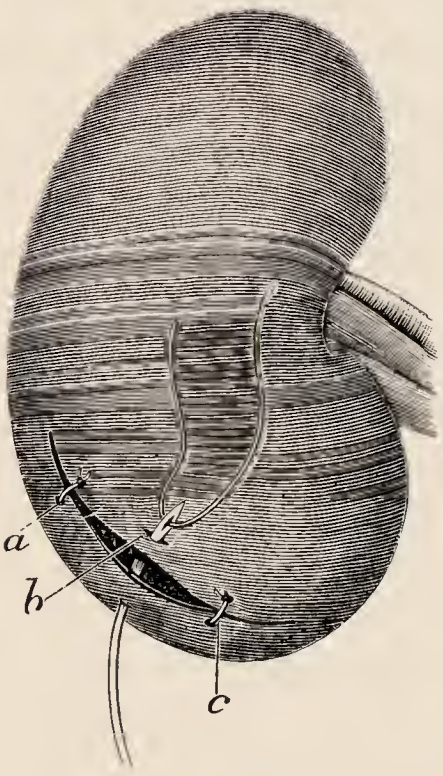



Fig. 1046.—Suture of the kidney, longitudinal wound. *a*, *c*. End sutures. *b*. Intermediate suture.

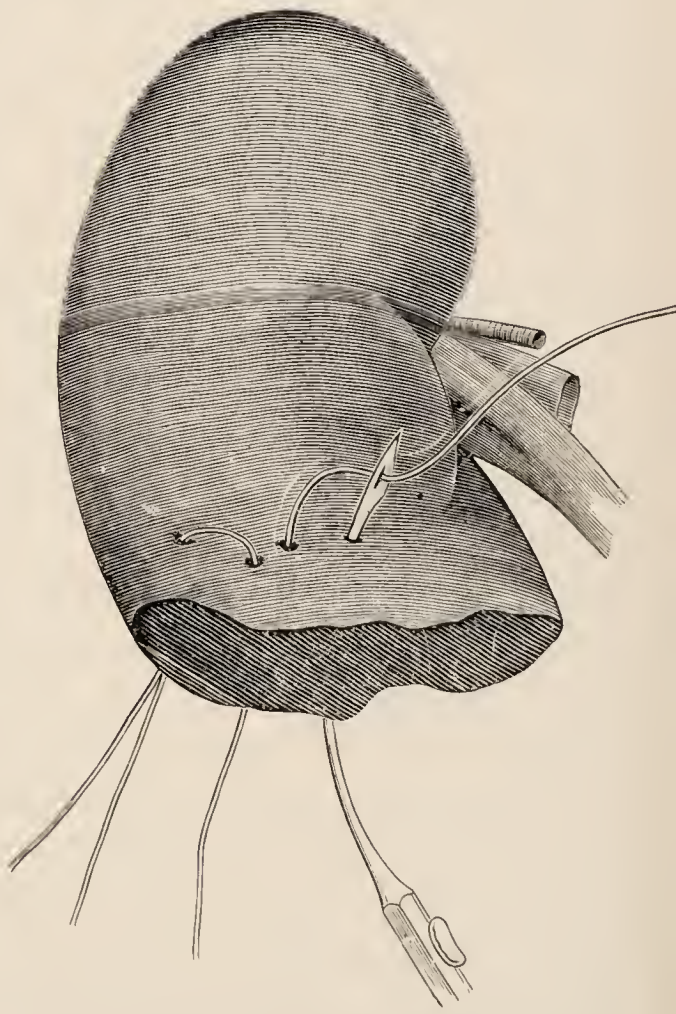


Fig. 1047.—Suture of the kidney, through and through suture.

*The Complications.* — Wounds of the large vessels of the kidney are so urgent that they may easily prove fatal at the outset, and if not, prompt and decisive action only will save the patient. Extensive extravasations of blood beneath the peritonæum, extending sometimes to the mesentery, mesocolon, pelvic cavity, etc., are of great significance because of the inability to remove the blood, and principally because of the dangers attending its becom-

ing infected. The pain and vesical tenesmus attending the free entrance of blood into the bladder, supplemented with the liability of infection, demand its prompt removal either by means of a large evacuating catheter or the additional use of a bladder evacuator (Fig. ). Failing in these, the squeezing of the organ by the hands passed through a small cœliotomy incision may be practiced (Willard), and even a free incision into the organ itself for the purpose may be necessary. Anuria from injury of one or both kidneys, from shock, from previous disease of the organ, and from injury of a single kidney, also uræmia which may depend on pressure from without due to pseudo-hydronephrosis, should be anticipated, and ample provision made for prevention and cure. The presence of peritoneal rupture and peritoneal extravasation of blood or urine should be determined and the dangers promptly obviated by washing and repair. This variety of injury is more liable to happen before ten years of age, as absence of the fatty capsule during this period brings the peritonæum into closer contact with the kidney and therefore renders it less resistant to injury. Severe renal colic dependent on the presence in the ureter of passing blood clots is not infrequent in these cases. A torn or plugged ureter lessens the amount, and modifies the character, of the contents of the bladder, blood not appearing. In the former instance subperitoneal extravasation of blood and urine may require free incision and drainage. Prolapse of the kidney through the wound is a rare complication, and is quite readily met by restoration of the organ to and fixation in the normal position. The possibility of the occurrence of secondary hæmorrhage should not be ignored, and care in securing the vessels is the most serviceable preventive.

*The Remarks.*—Usually the injuries are unilateral and both kidneys are healthy, therefore the wounds are non-infected except from without. Hæmorrhage from the cortical substance is less severe than from the medullary, because of the difference in the arrangement of the vessels in the respective structures.

*The After-treatment.*—Careful cleansing, good drainage, and proper attention to the complications and sequels embody the indications and suggest the manner of treatment.

*The Results.*—There are not a few conditions, such as a single kidney, diseased kidneys, injury of both kidneys, etc., which almost forbid the entertainment of the idea of a successful issue from any plan of action. The death rate from gunshot wounds is about 80 per cent; from punctured, about 25 per cent; and in rupture, about 33 per cent without and 23 with operative treatment. Primary nephrectomy gives a death rate of about 25 per cent, and secondary of about 39 per cent. The performance of nephrectomy increases the rate of recovery about 8 per cent. By the abdominal route the rate of mortality is 33.3 per cent, by the lumbar about 5 per cent less (Keen).

*Tuffier* reports the death rate of uncomplicated cases of rupture at 43, and of complicated at 87 per cent. *Grawitz* reports the mortality rate at 46.3 per cent in this class of cases.

## OPERATIONS ON THE URETERS.

The advisability of certain operations on the ureters is accepted, the labors of Van Hook, Fenger, Kelly, and others having established their utility beyond gainsaying.

*The Anatomical Points.*—The ureter is a fibro-muscular tube about one sixth of an inch in diameter, flattened antero-posteriorly, having a wall of about one twenty-fifth of an inch in thickness, nearly half of which is composed of muscular tissue. It is notably elastic, hence amenable to stretching in either axis. It is richly supplied with blood and therefore highly vitalized. It vigorously resists manipulative influences and promptly heals under favorable conditions. The ureter varies in length from ten to thirteen inches. The ureter may be partially or wholly double, and be connected with the kidney above and the bladder below in various abnormal ways. In sixty per cent of subjects it is narrowed at the three following situations: 1, at a point between an inch and a half and two inches and a half from the kidney; 2, at each extremity; 3, at the place where it crosses the iliac artery (Halle and Tanquary). The abdominal portion of the ureter lies on the psoas muscle and is covered by peritonæum, to which it is so closely adherent as to be reflected along with that membrane. The genito-crural nerve is closely associated with it, and therefore not infrequently irritated by the presence of calculi in the tube. The important vascular relations of the ureter are shown by Fig. 173.

The course of the ureter from the kidney to the brim of the pelvis corresponds to a line drawn from the junction of the inner with the middle thirds of Poupart's ligament vertically upward. The exact location at the brim is indicated by the intersection of a horizontal line drawn between the anterior superior spines of the ilium and a vertical one passing through the spine of the pubis (Tourneur). At the brim of the pelvis the ureters are about two inches apart. In the pelvis the ureter clings to the pelvic wall, passing outward across the obturator fascia, then curves toward the bladder. In the male it lies close to the free end of the vesicula seminalis, and is crossed at the inner side and above by the vas deferens. In the female it passes beneath the uterine artery in the broad ligament, runs parallel with and half an inch behind the cervix uteri, passes obliquely across the upper third of the vagina, entering the bladder near the middle of the former passage. In the bladder the ureter runs obliquely through the wall toward the median line and opens into the organ three fourths of an inch from its fellow and from the urethral opening. The portion of the ureter below the brim can be palpated through the rectum in the male and through the vagina in the female. Stones are arrested in the ureter most often in the upper part, with about equal frequency at the middle and lower parts.

The ureters serve the active purpose of transmitting the urine from the kidney to the bladder, and the discharge is accomplished in an intermittent manner, occupying from ten to twenty seconds in the passage. The escape of the urine into the bladder is characterized by sudden intermittent expulsions, each lasting two or three seconds. Whether or not the functions of

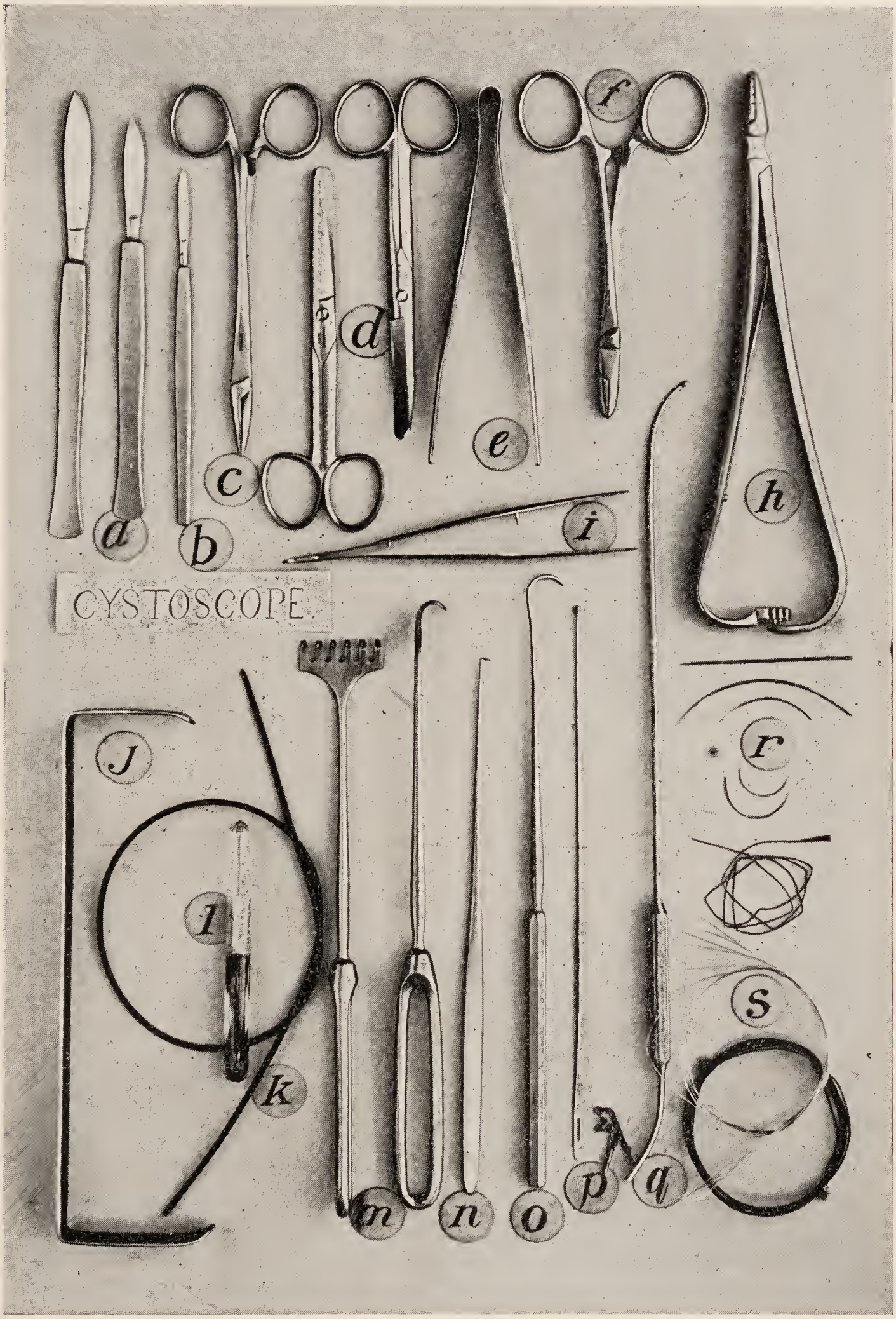



FIG. 1048.—Instruments employed in operations on the ureter.

*a*. Scalpels. *b*. Small knife. *c*. Forcipressure. *d*. Straight and curved scissors. *e*, *i*. Mouse-tooth and thumb forceps. *f*, *h*. Hollow-jawed and common needle-holders. *j*, *m*. Large blunt and hooked retractors. *k*. Gum-elastic urethral catheter. *l*. Chromicized catgut. *n*, *o*. Tenaculum and blunt hook. *p*, *q*. Long silver probe and metal urethral catheter. *r*. Delicate curved and straight needles. *s*. Catgut and silkworm gut. A waxed-tip catheter, dilating urethral catheters, and hard-rubber urethral bougies are often serviceable. Drainage agents, gauze pads, etc., should be provided.

the ureter are carried on in accordance with the established physiological manner and the urine escaping therefrom has the normal characteristics, are matters of great importance in connection with the significance of morbid changes in both kidney and ureter.

*The examination* to determine the condition of the ureters is of a comprehensive and technical nature. Their vesical openings and the submucous ridges indicating their course through the bladder wall and the urinary peculiarities, can be quite readily observed by means of the cystoscope (page 1159). The portions of the tubes contiguous to the vagina may be exposed and examined as they lie in the connective tissue through an incision made at the antero-lateral wall of the passage, aided by the introduction into their lower extremities of a bougie. Through an oblique incision (Fig. 1044) and reflection inward of the peritonæum and contiguous organs, the abdominal part of the ureter can be brought into view as it lies beneath the peritonæum closely associated with its own and contiguous vessels. If the bladder and rectum be empty, the lower extremities of the tube can be palpated by introduction of the finger high up into either of these passages, and although varying somewhat in position, they are quite readily distinguished under normal conditions as freely movable fibrous cords, by direct and bimanual pressure. Direct, deep abdominal palpation made along the semilunar line will often disclose the presence of a diseased ureter, especially at the brim of the pelvis, where the abdominal wall is thin and much relaxed. The introduction of a suitable sized, highly polished silk catheter into the ureter (page 851) enables one to determine the presence of constriction, of obstruction, and approximately their nature, and perhaps also the condition of the kidney itself.

**Wounds of the Ureter.**—Wounds of the ureter commonly arise from external force and from operative violence. The former kind are exceedingly rare because of the small size, firm structure, isolated and well-protected state of the tube. Those classed with operative violence include the damage incident to the loss of substance from removal of structural changes of and those contiguous to the ureter. The ureter, although rarely injured by external violence, sometimes suffers in contused, punctured, and gunshot wounds of the abdomen. How often stretching or crushing force causes the rupture can not be said, but at all events the injury happens more frequently above than below the brim of the pelvis, because maybe the tube is crushed against the transverse process of the first lumbar vertebra. The difficulty of framing a timely diagnosis in these cases often makes early cure impossible. The infiltration and infection attending a late diagnosis renders at the best the detection and repair of the rupture both difficult and uncertain. *Puncture*, *incision*, and *drainage* through the lumbar region or the abdomen in front are the primary measures employed.

*Puncture* of the retroperitoneal collection of fluids through the loin, although sometimes followed by cure, can not be regarded as a satisfactory method of practice.

*Lumbar Incision.*—A free incision in the ilio-costal space secures prompt escape of extravasated fluids, provides good drainage, and affords opportunity

for the exploration essential to determine the seat and extent of the injury, especially if the opening be extended along the iliac crest. However, it is rare indeed that the opening in the ureter will be found unless catheterism of the tube from below is practiced. If the opening is discovered it should be closed by sewing, if possible; but, if it can not be found, or the sewing fails to effect repair, proper drainage should be established pending further procedures based on the presence and condition of the other kidney and the results of Nature's efforts at relief. If the ureter is entirely severed, union of the divided ends by the accepted methods of practice or suitable transplantation of the proximal end (page 858) should be carried into effect. Failing in the wisest of these means, a permanent urinary fistula in the loin is the obvious outcome. In the event of failure of other means these fistulæ can be remedied by removal of the kidney, provided the other kidney be present and healthy, and the annoyance from the discharge becomes intolerable.

*The Remarks.*—In searching for the ureter the fact that it is carried forward with the reflected peritonæum, and that its line of attachment to this membrane is scarcely more than half an inch external to its connection with the spinal column, should be kept in view. The frequent prompt healing of incisions in the ureter made by the surgeon should emphasize the necessity of arranging the tissues in the instances of undetected injuries in a manner best suited to secure natural repair. A careful cystoscopic examination to determine the presence and condition of the fellow kidney should be made before radical means of relief are attempted.

*Primary* abdominal incisions for the relief of wounds of the ureter are made according to the nature of the wound. If for contused wounds, extraperitoneal approach is the better; if for gunshot and punctured wounds, direct approach along the course of the injury should be practiced. But in such wounds as these it is hardly to be expected that little else than good fortune will lead to suspicion of internal injury and its detection, particularly in the presence of the exigencies of the occasion. *The longitudinal, the incomplete oblique, and transverse wounds* of the ureter are closed by Lembert sutures as soon as discovered, and the line of union is fortified by infolding of the peritonæum or by an omental graft (Fig. 888). If the wound be transverse and incomplete, *Van Hook* advises the opening of the transverse wound upward and downward longitudinally; the cutting off of the four corners that result from the longitudinal incisions, and the union of the borders of the modified wound transversely, thus folding the ureter upon itself, as in "elbowing" the intestine (Fig. 865). *Fenger* suggests that this operation will probably be safe in extraperitoneal wounds. But if the wound opens into the peritoneal cavity, it is not certain that covering it with a fold of peritonæum will be sufficiently secure. He thinks it might be safer to complete the division of the ureter and unite the divided ends after the manner devised by Van Hook (*uretero-ureterotomy*). The complete transverse wounds are remedied by uretero-ureteral anastomosis (page 854).

*Primary nephrectomy* for relief from wounds of the ureter should not be entertained. Other things permitting, *secondary nephrectomy* should be

practiced in the involvement of the upper end of the ureter when annoyance from incurable fistula and from the pathologic processes at the seat of the injury becomes burdensome to the physical and mental welfare of the patient. In injury of the lower end, nephrectomy should not be done until after the possibility of uretero-vesical anastomosis and other forms of repair are dismissed.

*Operative violence* incident to the treatment of surgical conditions associated with the ureter often causes wounds of the tube, which are usually either longitudinal or transverse. The treatment of the longitudinal wounds is considered in connection with calculi of the ureter (page 867). The transverse wounds, especially when complete, are more difficult of treatment than the longitudinal, on account of the gaping and the tendency to stenosis. In complete transverse wounds of the ureter the divided extremities should be united together (uretero-ureteral anastomosis), unless a loss of substance of the tube forbids.

**Uretero-Ureteral Anastomosis.**—Four methods of this variety of repair are considered :

1. *The transverse end-to-end union with and without support.*

*Tauffer's Method.*—In this method the ends are directly united together with interrupted silk sutures while being supported by a catheter or other

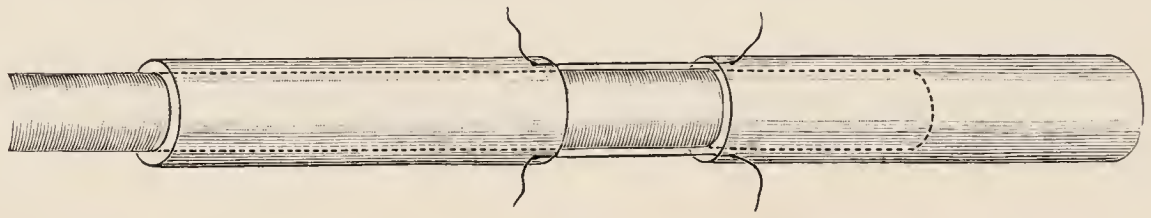




FIG. 1049.—Uretero-ureteral anastomosis, transverse end-to-end, with support. Tauffer's method.

suitable agent introduced into the lumen (Fig. 1049). Afterward the catheter is withdrawn through a slit made preferably in the distal end of the ureter opposite the extremity of the instrument.

*Schopf*, *Cushing*, and others united the ends by sewing without the aid of support (Fig. 1050).



FIG. 1050.—Uretero-ureteral anastomosis, transverse end-to-end, without support. Schopf, Cushing, and others.

2. *The oblique end-to-end union* (Bovée) (Fig. 1051).

*Bovée*, with the view of preventing obstruction at the seat of union from subsequent contraction, divided the ends obliquely, then dilated them for an inch, and united them together by means of alternating rectangular and interrupted sutures of No. 1 silk carried by a round straight needle down to, but not through the mucous membrane. The line of union was made addi-

tionally secure by four or five interrupted sutures supplemented by peritoneal investment at the seat of the operation, so adjusted as to exclude from the peritoneal cavity the seat of injury.

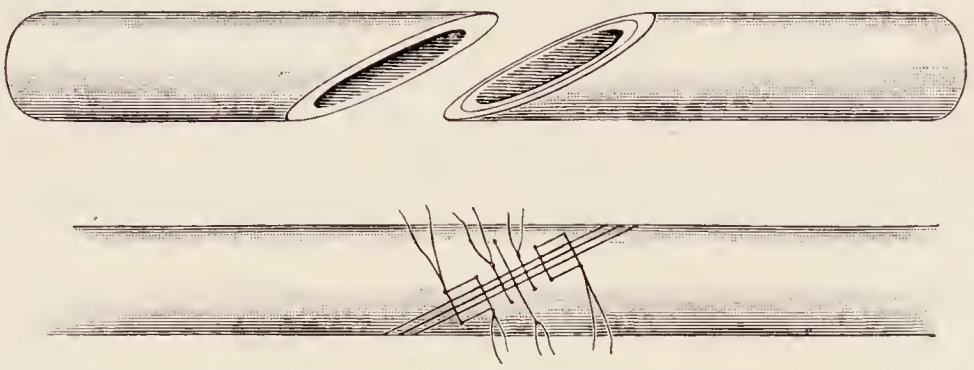


FIG. 1051.—Uretero-ureteral anastomosis, oblique end-to-end union. Bovée's method.

3. *Invagination, with and without support, also with and without splitting the ends.*

*Markoe*, in 1897, in a female patient invaginated and united over a catheter the ends of a ureter divided transversely at a point about an inch from the bladder. A No. 9 woven catheter was introduced into the distal end of the proximal part of the ureter, the free extremity of the instrument being carried outside of the wound. "After careful isolation of the field with sterile pads, two traction sutures were introduced close to the severed end of the kidney portion. The needles attached to these threads were then passed within the lumen of the kidney stump and made to emerge at two points about one sixteenth of an inch apart on the respective sites (Fig. 1052).

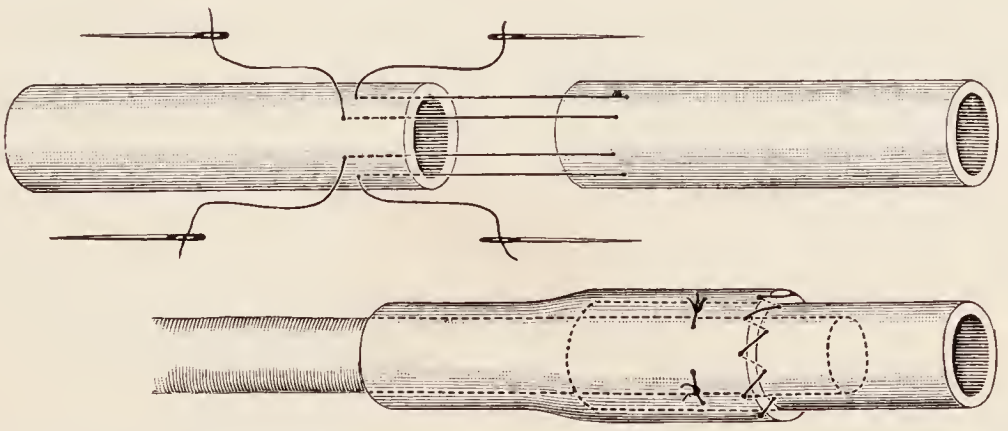


FIG. 1052.—Uretero-ureteral anastomosis, end-to-end invagination, with support, and without splitting. Markoe's method.

The free end of the catheter occupying the renal stump was then passed into the bladder, caught by a forceps introduced into the meatus and drawn down so that its mouth emerged into the vagina. The traction sutures were then slowly tightened, and in this manner the proximal extremity invaginated for about half an inch into the lumen of the distal portion. After tying the traction sutures a circular continuous suture completed the anastomosis." The line of union was further repaired by peritonæum, the wound closed except at the lower part, through which a gauze drain, arising from the seat of the operation, escaped. The catheter, which was allowed to remain in place for five days, when removed was perfectly smooth, having only a few crystals attached at the vesical end. For several days a "serous discharge," apparently mixed with urine, escaped. At the end of a month the patient was substantially well.

*Poggi* practiced invagination by first dilating the distal end and then drawing the proximal extremity into it by means of one or more traction sutures (Fig. 1053), which were then tied.

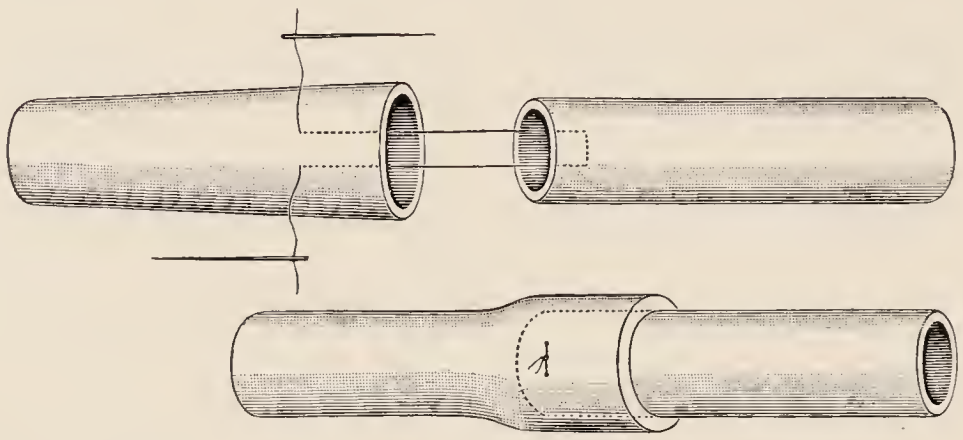


Fig. 1053.—Uretero-ureteral anastomosis, end-to-end invagination, without support and without splitting. Poggi's method.

*Robson* and *Winslow* attained their aim by first slitting up for a short distance the open end of the distal part of the ureter, causing invagination and union of the proximal end by traction sutures (Fig. 1054), the same as in the preceding method. The slit at the side was closed over the invaginated extremity with sutures. In neither of the last two instances was internal support employed, and in both additional security is given by sewing the free ends of the outer to the contiguous walls of the invaginated portions.

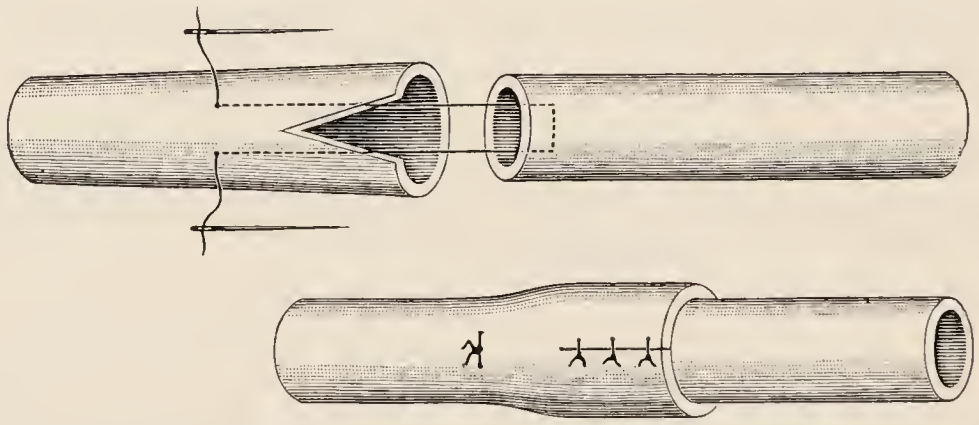


Fig. 1054.—Uretero-ureteral anastomosis, end-to-end invagination, without support and with splitting. Robson-Winslow method.

4. *Lateral Implantation* (Van Hook).—The method by lateral implantation, as announced by Van Hook in 1893, is practiced as follows: Ligature the distal portion of the ureter at a point an eighth or a quarter of an inch from the end with silk or catgut; beginning a quarter of an inch below the ligature, make an incision into the lumen twice as long as the diameter of the ureter with a fine, sharp-pointed scissors; make an incision from the open end of the proximal part upward a quarter of an inch (Fig. 1055, *a*); pass from within outward through the upper wall of the ureter, an eighth of an inch from the end, two very small cambric needles introduced an eighth or sixteenth of an inch apart and armed with a single suture of catgut; carry the needles through the slit into the tube for half an inch, thence out through the wall side by side (Fig. 1055, *b*); remove the needles and then make traction on the extremities of the suture, thus drawing the upper end of the ureter snugly into the lower portion, and tie the suture securely (Fig.

1055, *c*, *d*); surround the seat of operation carefully with peritonæum if the wound be intraperitoneal.

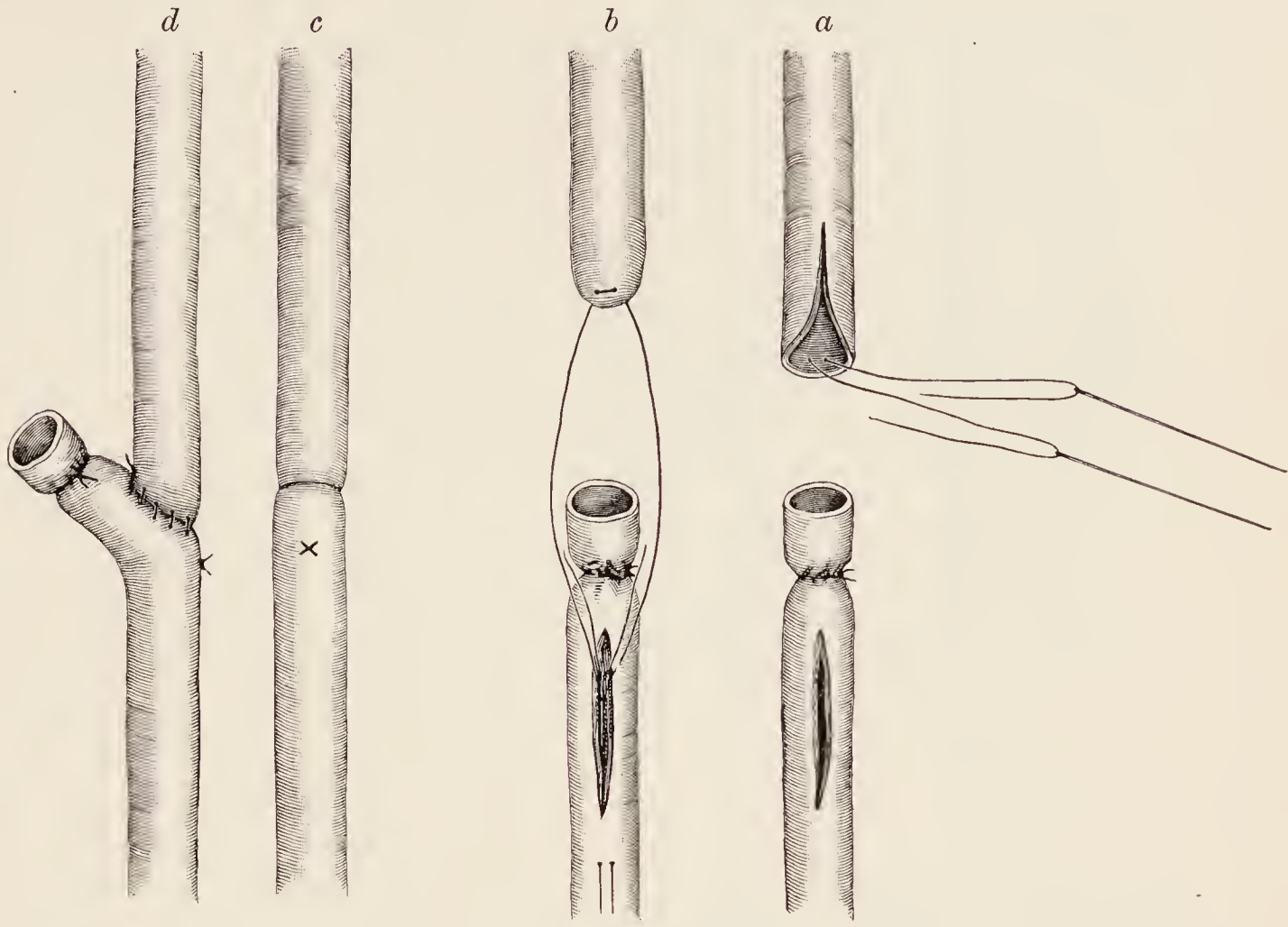



FIG. 1055.—Uretero-ureteral anastomosis, end-in-side implantation. Van Hook's method.

*Emmet's Modification.*—In certain instances the proximal end of the tube is permanently stretched from the over-distention incident to accumulation of fluids dependent on tumor pressure, calculi, etc. In these cases ready implantation requires that the end be diminished in size, often to a

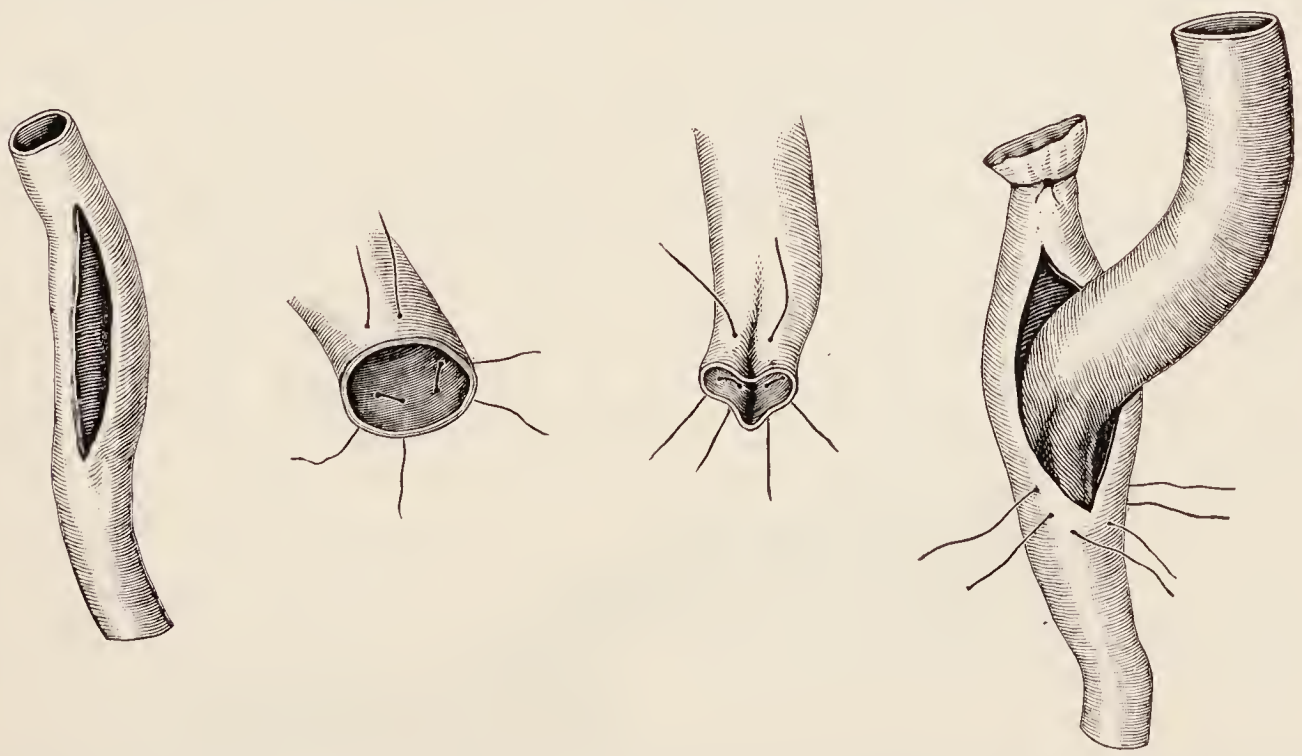


FIG. 1056.—Uretero-ureteral anastomosis, end-in-side implantation. Emmet's method.

considerable degree. Emmet attained the object by means of three short sutures introduced at different aspects of the dilated end. The manner of

the introduction and of the accomplishment of the purpose is sufficiently well indicated by the illustrations (Figs. 1056 and 1057).

*Kelly* and *Bloodgood* modified somewhat the manner of the introduction of the traction sutures, and added secondary sutures to the line of union. Two needles, each armed with a black silk suture, were introduced through the longitudinal incision into the lumen and carried thence outward respectively one through each lateral wall (Fig. 1058). As each suture had already been passed respectively through the outer wall of the proximal end, traction made upon them caused this extremity to enter the lower through the longitudinal slit, where it was fixed by tying the sutures. "Two additional sutures were passed through the lateral walls where the ends overlapped," thus completing the anastomosis. *Kelly* practiced the plan successfully on the human subject, and *Bloodgood* demonstrated it later on the dog. On the removal of the ureter from the dog at the end of three months, an interesting outcome was ascertained (Fig. 1059). The mucous membrane was continuous and no stricture was present.

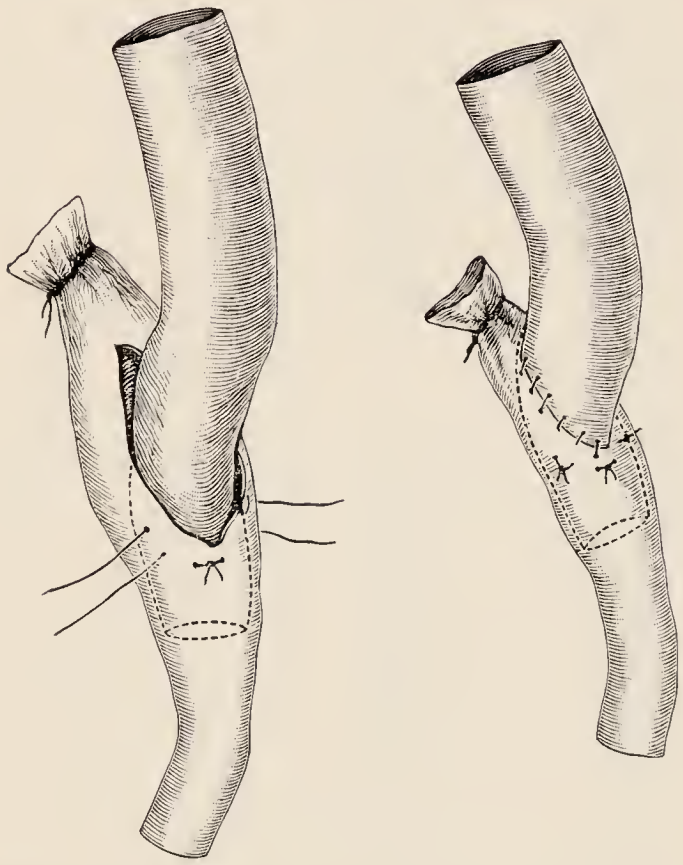


FIG. 1057.—Uretero-ureteral anastomosis. Emmet's method completed.

*The Results.*—First class: 12 operations with 2 deaths, neither of which was dependent on the ureteral procedure. Second class: 1 operation, entirely successful. Third class: 9 operations with 1 death. Fourth class: 5 operations with 1 death (Bovée).

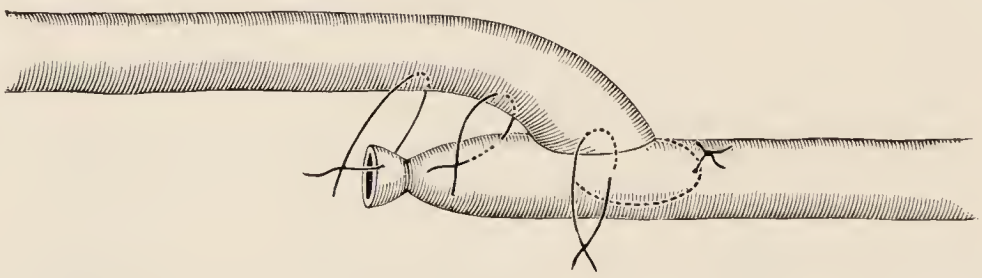


FIG. 1058.—Uretero-ureteral anastomosis, end-in-side. Kelly and Bloodgood's method.

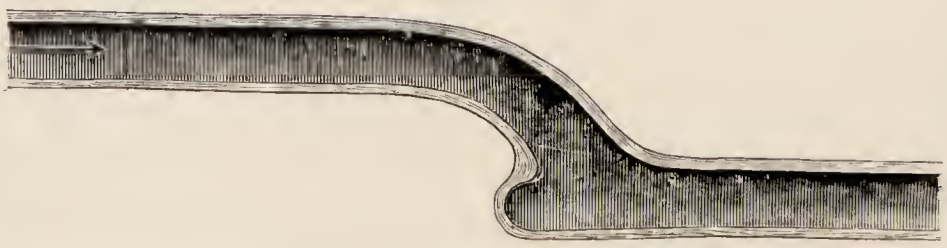


FIG. 1059.—Uretero-ureteral anastomosis. Result in Kelly and Bloodgood's method.

*The Choice of Operation.*—As yet one can not judge consistently of the comparative value of the various methods because of limited experience.

However, the best operation is the one that is most available and least liable to troublesome sequels. The transverse end-to-end methods appear to be more liable to leakage and stricture than do the others. The end-in-end plans, while less liable to leakage and stricture than the former, do not seem to be as exempt from these infirmities as the method of *Van Hook*, and its modifications. In instances of complete division with much dilatation, *Bovée's* method, although somewhat tedious and exacting in its technique, and apparently more prone to leakage than are the invagination methods, nevertheless is commendable and should be comparatively free from stricture sequels. In the presence of complete division with limited dilatation and also of a normal ureter, *Van Hook's* method is simple, expeditious, and effective. The employment of internal support in the technique, while affording temporary aid, complicates the procedure to a degree not justified by the comparative results of methods. About an inch of the ureter is required for end-in-end (invagination) anastomosis, and an inch and a half for end-in-side union.

**Implantation of the Ureter.**— When loss of substance has attended division of the ureter rendering approximation and union of the ends impossible, implantation of the proximal part into the bladder, the large intestine, the ureter, or upon the skin becomes necessary. The cæcal, sigmoid, rectal, etc., are the subdivisions of implantation into the large intestine. The implantation of one into the opposite ureter is an available plan of practice. The grafting into the pelvis of one kidney of the ureter of the opposite kidney may prove serviceable in some instances. The connection of the ureter with the vagina or urethra can not be favorably regarded except when other avenues of successful effort are closed.

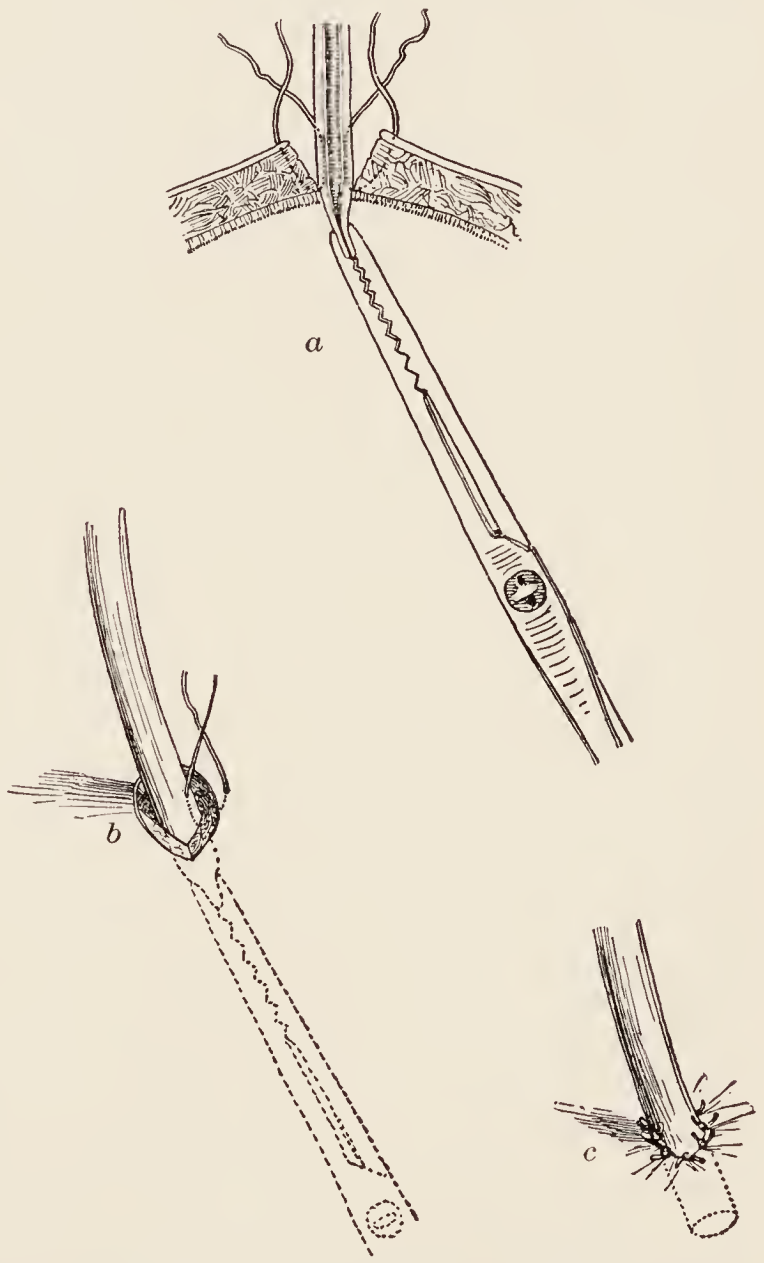



FIG. 1060.—The implantation of the ureter into the bladder, Kelly's method. *a*. Ureter drawn through opening in bladder by forceps passed through urethra. *b*. One suture introduced holding urethra in place. *c*. Ureter secured in place by deep and superficial sutures.

**The Implantation into the Bladder** (Ureterocystostomy). — The grafting of the ureter into the bladder is easier of performance than splicing the ureter (Fig. 1060). This variety of implantation may be either extraperitoneal or intraperitoneal. *The extraperitoneal method* was performed by *Baumm*, as follows:

The patient in question, a female, had a double ureter on the right side, one of which terminated at the mouth of the urethra causing dribbling of urine. Through a suprapubic incision *Baumm* made a small opening into the base of the bladder, caught and severed the abnormal ureter, implanted the proximal end into the opening at the base, and tied the distal one. He regards the vaginal route the better one in such cases, but employed this because of the virginity of the patient.

*Wetzel's Method.*— *Wetzel*, in a case of uretero-vaginal fistula, opened the abdomen, found the ureter at the brim of the pelvis, exposed and divided it near the middle of the broad ligament, closed the lower end with sutures and returned it to the pelvis, brought the kidney end into the upper part of the incision at the brim of the pelvis and carried it under the peritonæum by means of long forceps introduced beneath this membrane at the right of the bladder, closed the pelvic and abdominal incisions of the peritonæum, thus excluding the field of operation from the abdominal cavity. The bladder was then pulled so as to extend an inch and a half to the right of the end of the ureter and there the structures were joined together by sewing. An oblique incision of the bladder was made down to the mucous membrane, the end of the ureter divided obliquely, and the borders of its mucosa sewed to those of an opening made in the mucous lining of the bladder by cutting upon the end of a forceps carried upward through the urethra to the inner aspect of the oblique incision. The walls of the ureter were then united to the borders of the bladder incision, and the oblique channel was completed by suturing the bladder structures over the ureter. The organ was drained for four days through an independent opening. The recovery of the patient was satisfactory.

*Intraperitoneal implantation*, according to *Fenger*, was practiced successfully by *Novaro*, in 1893, for the relief of a patient with uretero-vaginal fistula following a vaginal hysterectomy performed for carcinoma extending into the broad ligament. Two months later a laparotomy was made with the patient in the Trendelenburg position, the ureter dissected from the vagina, slit upward for two fifths of an inch, unfolded, and united to an incision in the bladder three fifths of an inch long, and located about an inch and a half above the normal insertion. The gauze drainage introduced into the wound was impregnated for several days with the urine that escaped from the defective union. In ten days, however, repair had taken place, and the functions of the parts were permanently restored. *Krug*, who divided the ureter during the removal of a fibrous tumor, clamped the divided ends, and completed the operation. He then made an incision into the bladder, treated the end of the ureter as done by *Van Hook* for invagination, introduced it into the bladder incision and sewed it there, being careful not to obstruct the lumen. Several tiers of running sutures were made and the available amount of peritonæum employed "to build a solid wall" around the ureter. A catheter was kept permanently in the bladder for four days, after which catheterization was practiced every four hours. The patient recovered promptly without an untoward symptom, and left the hospital in four weeks.

*Penrose* removed an inch of the ureter which was involved in a carcinoma of the cervix, ligatured the distal and implanted the proximal end into the bladder by *Van Hook's* method, and closed the abdomen without drainage. The patient made a good recovery.

*Kelly* quotes a case, happening in the practice of Fullerton, of division of double ureter during the removal of the uterine appendages. In this instance the vesical ends were ligatured and the others introduced side by side into an opening made into the bladder at the superior portion and a little to the right, and sutured. This patient made a prompt and uneventful recovery.

*Baldwin*, who lately excised an inch and a half of the ureter in performing hysterectomy, was obliged, because of the loss of this amount, to implant the ureter into the bladder. In order to relieve the undue traction thus created, the wall of the bladder at the point of implantation was sutured to the stump of the broad ligament. This patient recovered.

*The manner of implantation* is a matter of great significance. The procuring of secure union, the prevention of constriction and of regurgitation from the bladder are important desiderata. The employment of aseptic care and the prevention of traction at the seat of grafting meet the first requirement. The raising of the bladder higher in the pelvis, and fastening it in place by suturing to the broad ligament or to other convenient structures, is a well-directed effort for the prevention of traction. Traction sutures, attached to the intravesical end of the ureter and passed out through the urethra and fastened to the dressings or held by weighting, are employed with success to neutralize the influence of the upward traction on the implanted end of the tube. The encroachment on the line of repair of drainage agents is objectionable, and should not be permitted when possible to avoid it. Drainage should not be employed in any instance, unless it is deemed as very essential. The splitting of the implanted end of the ureter, and the oblique introduction of the same through the bladder wall, are employed to prevent constriction and return flow respectively. The implantation together of the ends of the ureters and the intimate bladder wall into the bowel is a matter of brilliant conception and successful attainment (page 1154). Implantation may be accomplished quite readily, in some instances, by bringing the end of the ureter and the portion of the bladder into which grafting is to be made outside of the abdominal cavity.

*The Remarks.*—The abdominal route is preferable in all instances of ureterocystostomy, and especially in operative injuries of the ureter, as then the repair can be made before closure of the abdominal incision. Extraperitoneal is preferable to intraperitoneal implantation. However, in the latter plan the peritonæum is closed around the wound so carefully as to constitute in effect extraperitoneal implantation, so far as the wound is concerned. If the peritonæum be drawn too closely around the ureter at the site of implantation, constriction of the tube may follow (Martin). Ureteral fistulæ of congenital or acquired nature are sometimes treated by implantation made through the vagina, which affords a difficult and constricted field of action. Whenever diseased products are associated with the operation field, the intraperitoneal method should, if possible, be avoided.

*The Results.—Bovée* reports 37 ureterocystostomies for injury, 15 by the intraperitoneal and 2 by the extraperitoneal methods, the remainder not stated. In 12 of the former cases resection of the bladder was done. The mortality was a little over 2 per cent. Also 42 ureterocystostomies for various kinds of fistulæ, etc., are reported. Of these, 12 were intraperitoneal, 14 extraperitoneal, and 16 unstated. Four died, of which 2 succumbed to kidney complications at a later period.

**The Implantation into the Bowel.**—The technical difficulties of bowel implantation of the ureter are much less serious than the resultant infection of the kidney, which appears so likely to follow from the wanderings of the intestinal microbes. Experimentally the technique is successful, but practically the outcome was so frequently fatal in animals as to discourage for a while the attempt in man. Axial implantation of the ureter into the bowel, and its retention there by sutures; implantation of both ureters with a small associated piece of bladder wall (page 1154); and implantation of the ureters with associated mucous membrane, are the methods of practice commonly employed.

*Chaput* implanted the ureter into the colon for relief of a uretero-vaginal fistula following vaginal extirpation of the uterus. Through an abdominal incision he exposed and isolated the ureter, divided it transversely, ligatured the vesical end, and implanted the renal end by two rows of sutures into the colon. The patient voided, three or four times *per diem*, mixed urine and fæces, and was satisfied with her condition. No signs of infection of the kidney were present five months after the operation. In another case, a few months later, a fatal result followed.

*Martin's Method* (Axial Implantation). — The mechanism of this method is substantially as follows: 1. The ureters are caused to so empty into the bowel in its long diameter that the urine and fæces are discharged in the same direction. 2. The longitudinal burying for an inch or more of the ureters in the wall of the rectum permits the pressure of the outgoing fæcal matter on the mucous membrane to empty and compress the lower extremities of the ureters. The muscular contractions of the gut contribute their influence to these results.

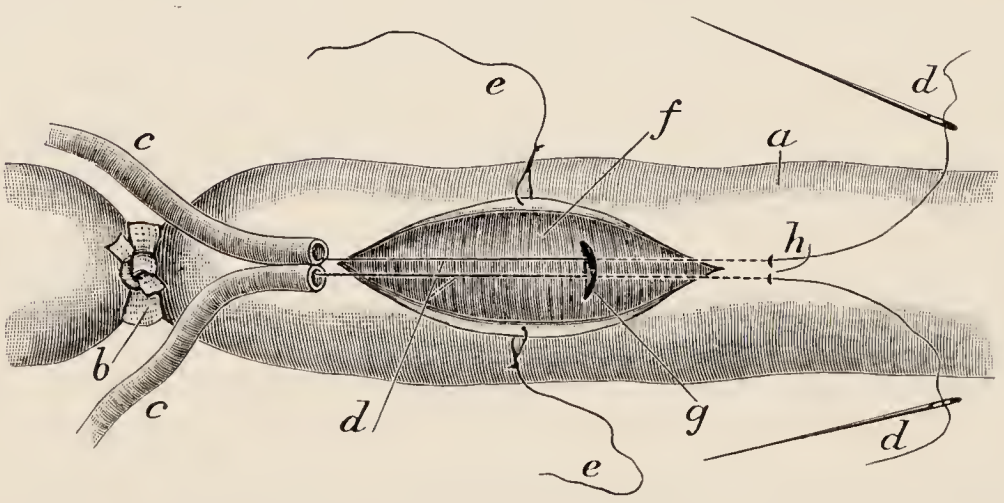



FIG. 1061.—Implantation of the ureters into the bowel, Martin's method. *a*. The rectum. *b*. Point of constriction of the bowel. *c*, *c*. Ureters joined together in parallel position. *d*, *d*, *d*. Silk suture armed with needles attached to the ureters and passing into and out through the wall of the bowel. *e*, *e*. Traction sutures for drawing apart the borders of the wound. *f*. Muscular fibers of the bowel. *g*. Opening for the passage of sutures. *h*. Points of escape of ends of traction sutures.

*The Operation.*—Cleanse the bowel thoroughly and place the patient in the Trendelenburg position; expose the rectum through an abdominal inci-

sion; incise the peritonæum over the lower three or four inches of the ureters down to the bladder; dissect out the lower three inches of the ureters and tie each with a strong ligature near to the bladder, severing them close above the ligatures (Fig. 1061); bring the renal extremities of the ureters forward and join them together in a parallel position (*c*, *c*) by passing through their outer walls a long, fine silk suture armed at each end with a cambric needle; make a two-inch longitudinal incision at the uppermost part of the wall of the rectum down upon its muscular coat; expose by dissection an oval surface an inch in width at its greatest transverse diameter, drawing apart the flaps with traction loops (*e*, *e*); close the bowel above the incision with a clamp or other suitable means (*b*); make an incision into the bowel at a point of the oval space (*f*) three fourths of an inch from the lower end (*g*), large enough to admit the ends of the ureters; pass downward through the opening (*g*) the doubly armed ligature (*d*, *d*, *d*), causing the needles to escape anteriorly about an inch below the place of entrance (*h*); draw the ureters through the opening into the bowel as far as the sutures will permit (Fig. 1062). Elevate the ureters (*c*, *c*) to a right angle with the bowel, uniting them low down to its fibro-muscular coats by fine catgut sutures so passed as not to invade the cavity of the gut or constrict the lumen of the tubes; place the ureters on the denuded surface parallel with the bowel, and unite them at either side to the muscular coats of the intestine; infold the muscular coats by uniting them together with fine silk, thus burying the extremities of the ureters the distance of an inch; cover in the wound up to the bifurcation of the ureters, uniting the divided peritoneal borders with fine silk (*e*, *e*); increase the security of the implantation by additional fine silk sutures where needed. The abdominal wound is then closed, leaving sufficient room at the lower angle for the escape of a small gauze drain extending out from the seat of implantation.

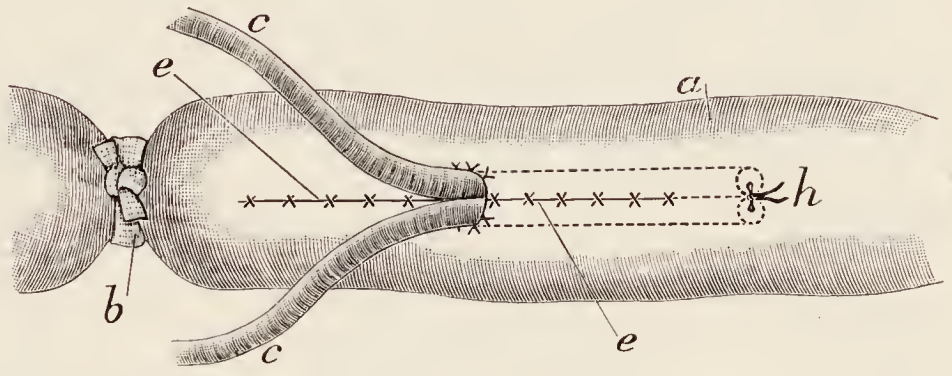



FIG. 1062.—Implantation of the ureters into the bowel, Martin's method. *a*. The rectum. *b*. Point of constriction of the bowel. *c*, *c*. The ureters. *e*, *e*. Union of peritoneal borders. *h*. Traction sutures tied.

*The Remarks.*—The renal portions of the ureters should be controlled from the outset by pressure to prevent the escape of fluids. This method of practice has been applied both to dogs (thirty-eight) and human subjects (three); to the latter in one instance of removal of the bladder, and in another for exstrophy; the third is not stated.

*The Results.*—In the case of cystectomy the patient lived three years. In the case of exstrophy the implantation was only a partial success. Of the dogs, 4 lived an "indefinite time," in 2 of which both ureters were implanted in the rectum.

**Fowler's Operation.**—Fowler aimed to supplement the restraining influence of the circular fibers of the gut on the lumen of the ureter, during defe-

cation, with a valve of mucous membrane so arranged as to provide greater security against ascending infection then and during the presence in the bowel of excrementitious substances.



FIG. 1063. Implantation of the ureters into the bowel, Fowler's method. Oblique division of the ureter.

*The Operation.*—Thoroughly cleanse the bowel and dilate the anal sphincters; place the patient in the Trendelenburg position and open the abdomen in the median line; draw aside the intestines and identify the ureters and their relations with the vessels; incise the peritonæum; expose and trace the ureters to the bladder wall; sever the ureters on a line with the bladder wall and cut the proximal ends obliquely (Fig. 1063); make a longitudinal incision in the anterior wall of the rectum, through the serous and muscular coats, two and three fourths inches long; dissect carefully aside these tissues, exposing a diamond-shaped submucous space (Fig. 1064); introduce traction loops and draw apart the borders of the wound; cut in the mucous membrane, at the lower half of the field, a tongue-shaped flap with the base upward; double upward the tongue-shaped flap on itself, so that its apex will correspond to its base; join the halves together in this position with a suture at each side, thus forming a flap with a double surface of mucous membrane; place the ureters side by side upon the flap, with their obliquely cut surfaces undermost (Fig. 1065); secure the ureters in position with sutures, being careful that they do not invade the

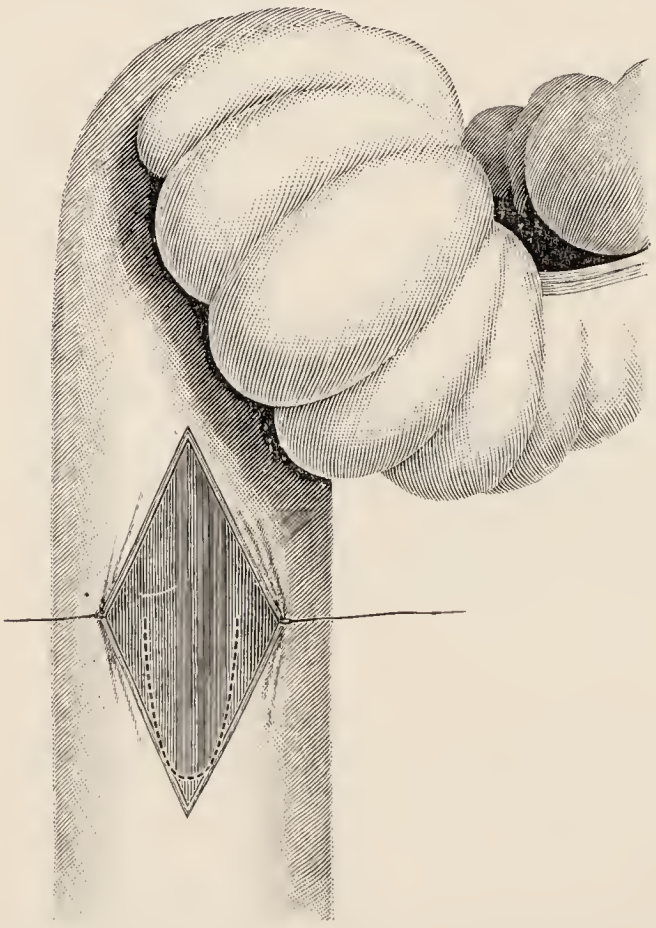


FIG. 1064.—Implantation of the ureters into the bowel, Fowler's method. The tongue-shaped mucous flap.

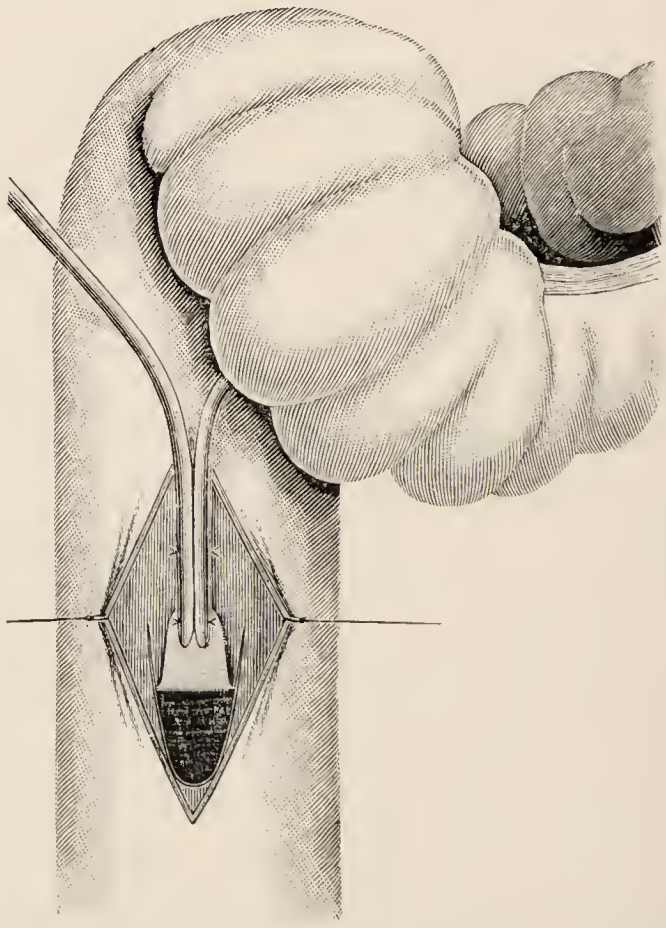


FIG. 1065.—Implantation of the ureters into the bowel, Fowler's method. The mucous flap attached to the ureters.

lumen of the tubes; push the valve and the attached ends of the ureters into the rectum, and close the rectal wound as follows: close the gap in the

membrane left by the reflected flap with catgut sutures (Fig. 1066); close the wound of the sero-muscular coats with silk sutures, causing one or two in their passage to include the wall (not the lumen) of the ureters for better security (Fig. 1067); unite the abdominal wound and place the patient in bed.

*Fowler* claims the following advantages for this method, which, it seems to us, the history of the case in question justifies: 1. "An efficient perma-

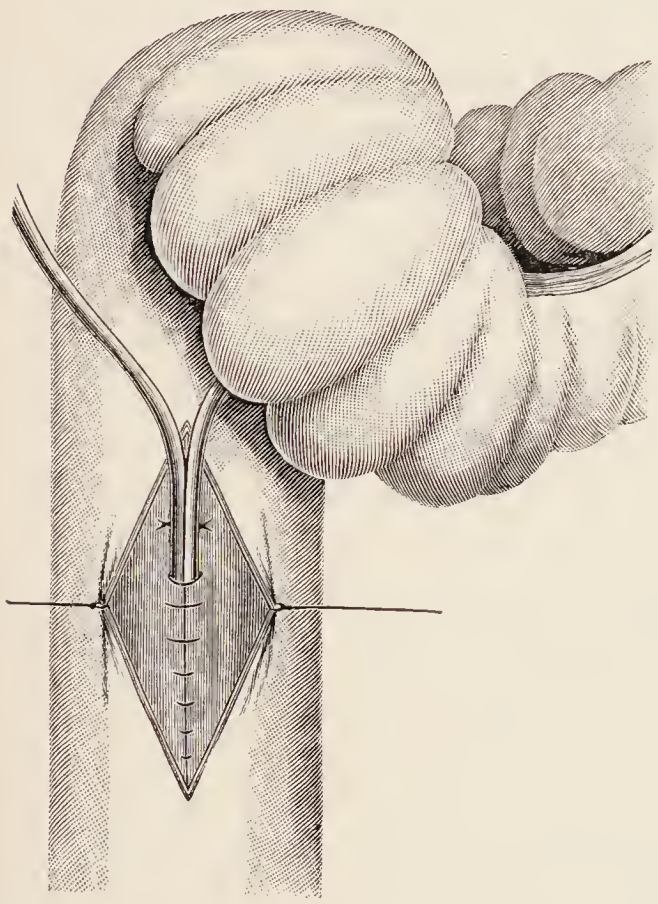


Fig. 1066.—Implantation of the ureters into the bowel, Fowler's method. Gap in mucous membrane closed.

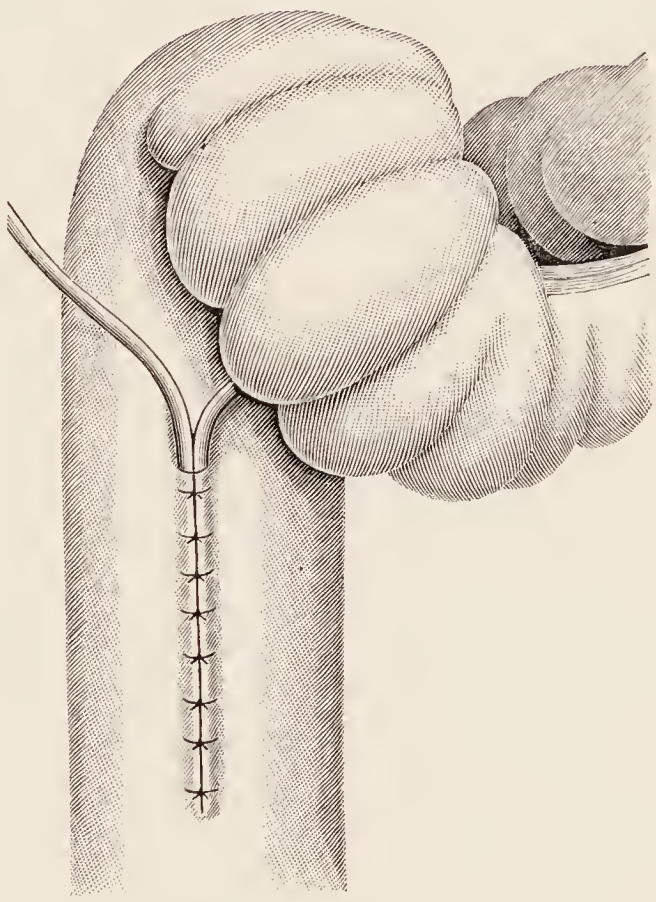


Fig. 1067.—Implantation of the ureter into the bowel, Fowler's method. Sero-muscular coats united.

nent valve, with a mucous surface applied to the open mouths of the ureters, is provided. This valve is so situated that it is closely applied to and occludes the open ends of the ureters as the rectum becomes filled with urine, or when fæcal matter descends."

2. "The placing of the ureters in the submucous space of the rectal wall, for a distance of three or more centimetres (an inch and a quarter or more) above the point where they enter the cavity of the rectum, affords an additional safeguard against renal infection. In this situation the circular muscular fibers of the bowel wall compress the ureters and secure occlusion at this point during defecation."

*Krynski* exposed the submucous tissue of the rectum, introduced the ends of the ureters into the rectum, and closed the wound, fastening the ureters in place.

*Maydl* transplants the ureters with an elliptical piece of the trigone of the bladder (page 1154) to the bowel, thus preserving the natural mechanism of the ureteral openings. This method of practice, which certainly is more complicated than either Fowler's or Martin's methods, is commended by the outcome that seems to follow its employment.

*Vignoni*, *Pisani*, and many others have devised ingenious plans of action, but it seems to us that those already expressed in detail are better suited to the purpose.

The measures of *Gersuny*, *Mauclaire*, and *Tizzoni*, directed to division of the bowel, with the idea of establishing an independent delivery of the excretory products, do not require special consideration.

*The Results.*—Bowel implantation has been performed 65 times on man, with a mortality of 18: 6 died promptly from shock; 7 lived from five days to two years, dying from infection of the kidney or other consequent complications. The causes of death of the remaining 5 are obscure.

**The Implantation on the Skin.**—Implantation on the skin will quite likely be followed sooner or later by kidney infection. Yet, while this is true, the disease of a kidney may be so extensive as to favor its employment in lieu of the more effective bowel implantation. Implantation on the skin can be made through a buttonhole opening (Pozzi) in the loin (upper end), or at the seat of the abdominal wound. The technique of either is comparatively simple. The extension of the ureter through the abdominal cavity provides a bandlike structure that exposes the intestines to the subsequent dangers of entanglement and obstruction.

In view of the dangers of infection, and the consequent need of a substitute for skin implantation, as previously considered, *Rydygier* proposed to implant both ends on the abdominal wall and establish a continuity of function by a plastic operation, which consists in turning over them a flap of skin so as to provide for their loss of substance. *Van Hook* proposed to establish a diverticulum from a flap made at the posterior wall of the bladder, of sufficient length to properly join the renal end of the ureter. While these methods seem feasible, they lack the full confirmation of actual practice.

*The Remarks.*—There is now little need of considering the availability of skin implantation. The improved technique of bowel grafting and the possibility of uretero-ureteral anastomosis, added to the comparatively fatal outcome of the first, reduces its usefulness of application mainly to cases of impending nephrectomy, except in single kidneys.

*The Results.*—*Bovée* reports 10 cases of skin implantation. The rate of mortality in those of the number (6) with complete record is about 67 per cent.

*Implantation into the vagina* has been practiced but 3 times, and in each instance with success. There is but little, indeed, to commend the practice, except for some reason the unavailability of other and completer methods.

*Uretero-urethral anastomosis* (Sonnenberg), or the implantation of a ureter into the urethra, has been performed in 5 instances, in 4 of which the cure of exstrophy of the bladder was the reason for operation.

*The anastomosis* of the ureter of one side with its fellow, and even possibly with the pelvis of the opposite kidney, is not an impossible accomplishment, although of unestablished utility. The lowering of a kidney sufficiently to permit the joining of the ends of a severed ureter may be of service when implantation implies greater danger than does displacement of the kidney.

**Ureteral Calculus.**—Calculi are commonly arrested at the upper and lower portions of the ureter. The technique of the operation of removal is modified by the situation of the calculus.

*At the Lower Portion* (Vesical).—Calculi at this situation can be removed through the *bladder*, *vagina*, or *rectum*. Calculi protruding into the bladder from the ureter, and those near the orifice of the ureter, can be removed directly with or without dilatation of the vesical opening, through a suprapubic incision of the bladder and through the urethra directly. When covered with mucous membrane, the membrane is excised and afterward repaired or not by sewing, as seems best.

*Removal through the Vagina.—Emmet* and *Cabot* have each demonstrated the feasibility of this plan of action successfully on the living subject; both patients recovered. In each instance an incision was made through the vagina upon the tumor, the calculus released and removed, and drainage established. The incision should be made toward, rather than from, the neck of the bladder, to avoid division of the fold of retrovesical peritonæum.

*Removal through the rectum* has been successfully performed by Ceci.

*At the Middle and Upper Portions.*—In either of these portions of the ureter an abdominal incision is necessary to reach the seat of the obstruction. The incision is carried down to (*extraperitoneal ureterotomy*) or through the peritonæum (*transperitoneal ureterotomy*), as may seem needful. In the former instance the incision is made in the iliac region, as for ligature of the common iliac (Fig. 176), or in the lumbar, as in exploration of the kidney (Figs. 1042 and 1044), as seems best suited to reach the obstruction. The peritonæum is then reflected upward cautiously with the fingers, with the patient lying on the opposite side, until the objective point is reached. The field of operation is carefully isolated to prevent infection, the ureter opened longitudinally, and the stone removed.

In a series of five cases, after cleansing the wound, the ureter was closed with fine interrupted sutures in two, and left open in three, instances. Proper drainage was provided in each instance. All of the patients (five) recovered.

*Extraperitoneal ureterotomy* can be performed after diagnosis of the nature and seat of the obstruction is made through a direct peritoneal incision, which is closed at once. *Transperitoneal ureterotomy* can be performed in those cases that are intrapelvic, and not amenable to approach by another method. Two instances are reported by Fenger in attestation of the worth of the procedure: one died and one recovered.

*The Remarks.*—Scrupulous care should be exercised to prevent infection, especially in the cases characterized by pus collections at any situation, notably at the pelvic portion of the ureter, and in the presence of exposed serous surfaces. A stone at the upper end of the ureter may be displaced upward into the pelvis of the kidney by manipulation with the fingers or needle pressure, and then removed. However, as Fenger very properly believes, this attainment is not so important if the stone can be directly removed through an extraperitoneal incision.

*The Results* of removal of stone from the ureter are 3 deaths in 17 cases.

**Ureterectomy.**—Ureterectomy is performed in tuberculous and suppurative diseases of the ureters. The varieties of ureterectomy are the *primary*, where the ureter and kidney are removed simultaneously; and the *secondary*, where the removal of the kidney precedes that of the ureter. In each of the foregoing the ureter may be *partially* or *completely* removed by either the *transperitoneal* or the *extraperitoneal* route. The location and length of the incision for exposure of the diseased structures varies according to the extent of the disease and the route adopted for its removal. In total extraperitoneal nephro-ureterectomy the incision commended by Morris (Fig. 1044) is suitable. In partial operation of this kind the oblique incision, extended if necessary to the outer border of the rectus (Fig. 1042, *c*), is ample. In the transperitoneal operation an incision is made along the outer border of the rectus abdominis of sufficient length (page 843) to permit of the inspection and removal of the kidney, and it is extended thereafter suitably, to afford ample room for examination and extirpation of the diseased portion of the ureter. In partial or total ureterectomy the incisions of the respective routes of approach (transperitoneal and extraperitoneal) are made in conformity with the demands of the case. In the extraperitoneal operations the peritonæum is exposed by division of the superimposed tissues along the line of incision. The peritonæum is carefully raised from the overlying tissues by means of the fingers, and reflected toward the median line of the body, until the fatty capsule of the kidney or the ureter is exposed. In the first instance the kidney is cautiously enucleated from its fatty environment (page 842) and removed, the ureter remaining attached. In the second instance the upper end of the fistulous ureter is discovered, clamped and raised, and in both instances the ureter is carefully separated downward from its immediate surroundings to a distance corresponding to the extent of its disease. The contents of the lumen are then pushed upward with the thumb and fingers, and a clamp is applied close to the healthy part, around which a ligature is tied, and, after careful isolation with gauze at the latter point, the ureter is divided through the sound portion with scissors, and the diseased structures are removed. The

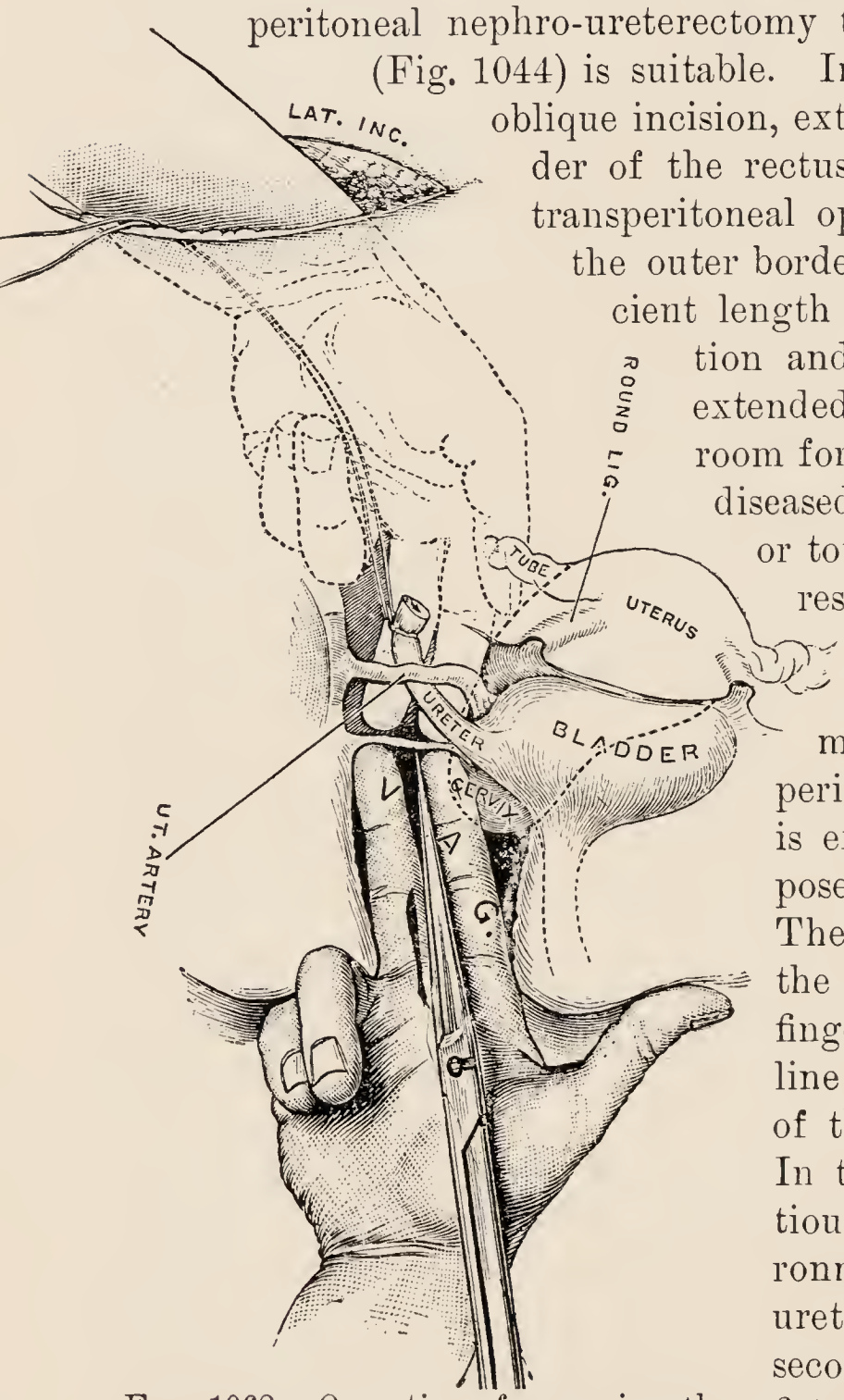



FIG. 1068.—Operation of removing the lower end of the ureter through vaginal vault, Kelly's method. The fingers of the upper hand holding up the uterine artery during perforation of the vaginal vault by the scissors.

ureteral stump is then cauterized so as to destroy its infected tissue, and dropped back into place. The wound is wiped with aseptic care, and closed entirely, or the lower end is left open for the escape of a small temporary gauze drain, when its presence is required. *Kelly* advises that, if the kidney be tuberculous, and the ureter be thus affected in any instance, the latter be removed, if practicable, the entire length. To properly accomplish this in the female the ureter is made taut by moderate traction, and its separation is extended to the brim of the pelvis by the fingers, where the iliac artery is felt. The entire hand is then introduced into the wound and passed between the peritonæum and the abdominal wall, thence beneath the peritonæum and the wall of the pelvis, freeing the ureter down to the broad ligament, which is recognized by a sense of resistance and the impression that it seems to pass into the broad ligament, at which point the pulsation of the uterine artery (Fig. 1068) is felt above. At this situation the ureter is caught with forceps, and a stout ligature is carried around it and tied, and about three quarters of an inch more is freed by means similar to those employed before. The contents of the tube are then pushed upward, and the tube clamped to prevent their escape when the ureter is divided just above the ligature with long scissors passed into the wound from above. The stump of the ureter is now removed through an extension of the abdominal incision, or through the vagina. If by the latter way, the vagina is thoroughly cleansed, and the patient placed on the side opposite to the operation. The first and second fingers of the hand corresponding to the side on which the ureter lies, are passed up to the vaginal vault, and caused to oppose the fingers of the opposite hand (Fig. 1068). The uterine artery is raised out of the way by a digit of the inner hand between the fingers of which the ureter should lie. An assistant now introduces along the fingers of the operator to the vaginal vault a long, sharp-pointed scissors, pushing them through the thin-walled septum three fourths of an inch from the cervix into the abdominal cavity. The scissors are withdrawn with the blades opened sufficiently to make an opening about three fourths of an inch in diameter. A long forceps is then carried through the opening, the ligature grasped, the ureteral stump drawn into the vagina, and held while the abdominal wound is being closed (Fig. 1069). The patient's

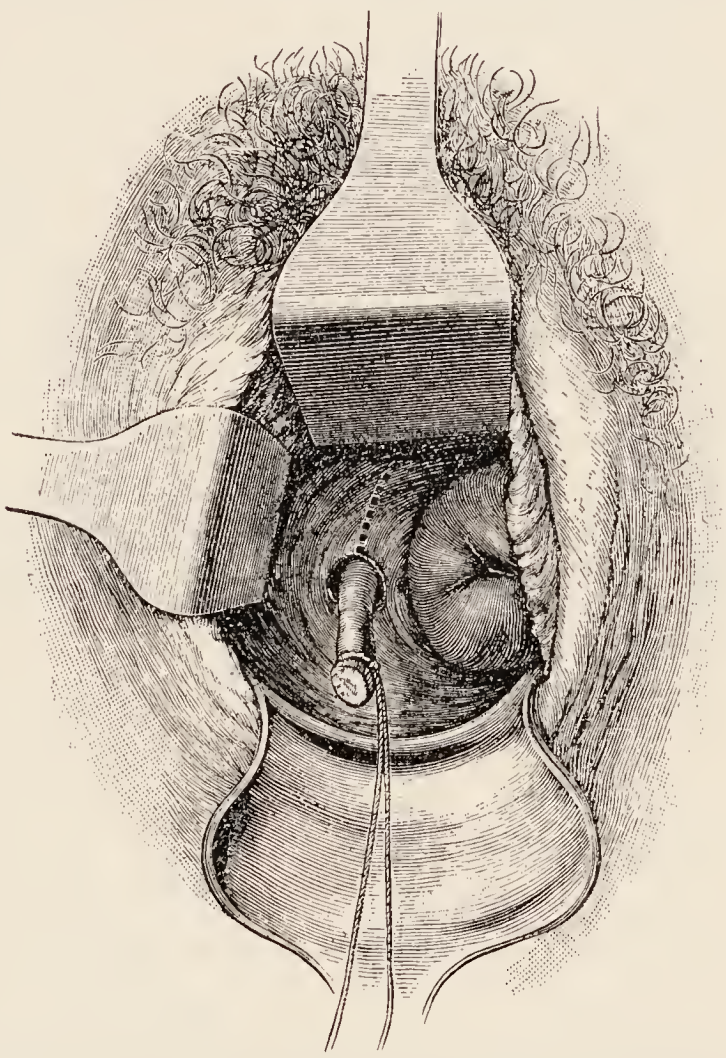


FIG. 1069.—Operation of removing the lower end of the ureter through vaginal vault, Kelly's method. End of ureter exposed. Dotted line indicates direction of incision to expose vesical end of ureter.

condition permitting, she is placed in the lithotomy posture, and the vault of the vagina exposed by retractors, and the cervix pushed away from the opening and held by bullet forceps. The ureter is made tense by traction on the sutures, and a curved incision is formed in the vaginal vault from the junction of the anterior and lateral walls, forward and upward, beneath the base of the bladder to a point a little more than half an inch from the vesical end of the ureter. Through this incision the ureter is freed to the vesical attachment, and ligatured close to the wall of the bladder, and cut off. The vaginal wound is closed with sutures, leaving room for the exit of a gauze drain extending from the connective tissue above through the opening into the vagina.

*In transperitoneal exposure* of the kidney and ureter the large and small intestines are displaced toward the median line, and the posterior peritonæum is divided at the outer side of the colon, and reflected inward until the ureter is disclosed, when, if the operation be primary, the ureter is traced upward to the kidney, which is enucleated and removed in the usual manner (page 843), leaving the ureter attached. In either primary or secondary operations the ureter is separated from above downward as far as practicable, ligatured, divided, and sterilized the same as before. The posterior peritonæum falls into proper position, therefore does not require sewing. The abdominal wound is closed throughout, except at the points left for the escape of such drainage agents as may be desired.

*The Precautions.*—As the ureter is made fragile by disease, only careful traction on it should be made, and even this is often attended with breaking. Prompt control of the broken ends and thorough removal of the discharged matters should be exercised at once, to prevent dissemination of infection. Before ligaturing the ureter always push aside its contents; before dividing it, carefully protect the immediate tissues from possible infection; when divided sterilize the stump, turn the end inward, and close it with a suture. It may be necessary to ligature the uterine artery during the removal of the ureter, because of their intimate normal association (Fig. 173). The separation of the ureter downward from the iliac artery to the broad ligament is difficult and complicated, because of the blindness of the procedure and the proximity of important structures. In incising the vaginal vault carefully avoid the uterine artery.

*The Remarks.—Fenger* considers pain in the side as a common sequel of nephrectomy with retained ureter. The same authority especially favors the inguinal incision and the route along the vas deferens as a guide to the distal end of the ureter. Rectal distention raises the bladder and renders the vesical portion easier of access. The extraperitoneal is the preferable route.

*The Results.*—In ureterectomy the results are favorable indeed to life. Permanent fistula is a rare sequel of nephrectomy. Temporary fistulæ happen in from 7 to 25 per cent of the cases. Tuberculous complications beget permanent fistula.

**The Relief of Valve Formation.**—Valve formation at the beginning of the ureter causes an interrupted and perhaps permanent obstruction to the

escape of urine from the pelvis, followed by distention of the pelvis with pus and urine.

In speaking of this operation, *Fenger* says: "The operation for valve formation can be best done by the extraperitoneal lumbar incision (Fig. 1042). The dilated pelvis or hydronephrotic sac is easily found, and is opened by a longitudinal incision. The opening of the ureter into the sac should be looked for, but can not always be found, as in some cases it is very narrow. In such cases it may be located by incising the ureter below the sac and passing a probe upward toward the pelvis (Fig. 1070). The valve or inner wall of the ureter running in the sac is now divided longitudinally from the opening in the sac, and the resultant wound treated in one of three ways: (*a*) By turning the flaps out and uniting them to the inner walls of the sac by sutures (Küster, Trendelenburg) (Fig. 1071); (*b*) by drawing the corners of the longitudinal incision together with one suture, transforming the longitudinal into a transverse wound, as in my operation; or (*c*) by uniting the wound longitudinally with numerous fine silk sutures"; or by "taking in the two outer coats of the ureter and sac, and avoiding the mucous membrane" (Mynter).




Fig. 1070.—Operation for cure of valve formation, Küster-Trendelenburg method. *a*, *c*. Wall of pelvis of kidney. *b*. Opening of ureter into pelvis.

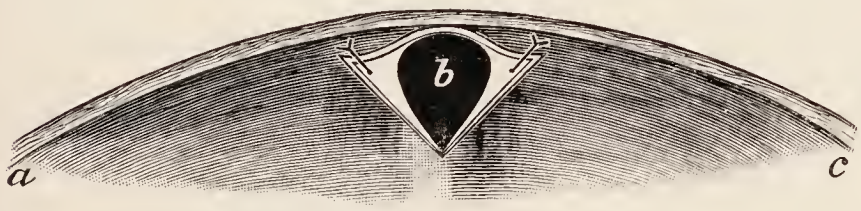



Fig. 1071.—Operation for cure of valve formation, Küster-Trendelenburg method. *a*, *c*. Wall of pelvis of kidney. *b*. Ureteral opening slit up, flaps turned aside and stitched to the wall of the pelvis.

In the first case in question *Fenger* practiced the following technique: After exposure of the kidney it was opened through the convex surface (*x*) with a Paquelin cautery, the opening dilated with forceps, and digital palpation was made of the pelvis and calices. Stone was not found, nor could the entrance of the ureter be dilated by the finger or probe. The posterior surface of the pelvis (Fig. 1072, *c*, *c*) was opened, and the borders of the wound were drawn apart. At the lower posterior portion of the inner wall the opening of the ureter (*d*) could be

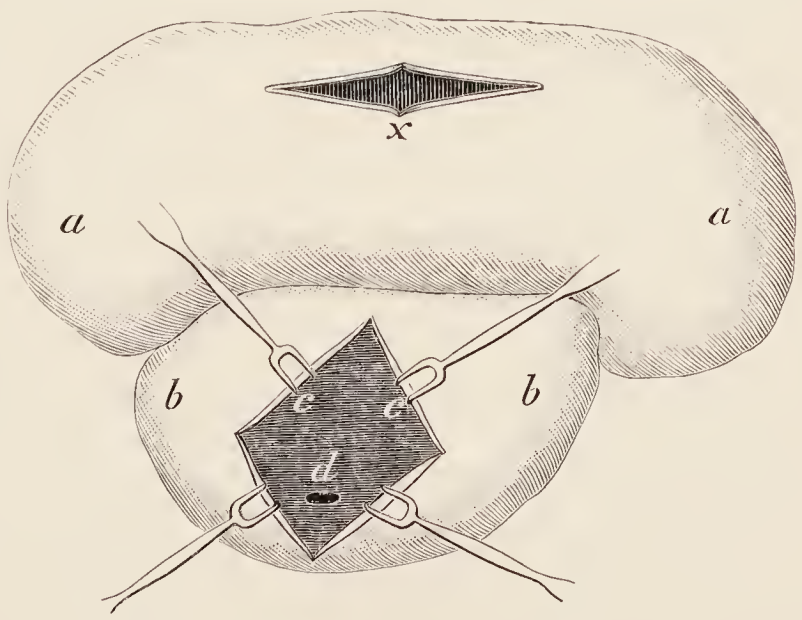



Fig. 1072.—Operation for cure of valve formation, Fenger's method. *a*, *a*. Kidney with dilated pelvis. *x*. Opening from nephrotomy. *b*, *b*. Dilated pelvis. *c*, *c*. Borders of opening made on posterior surface. *d*. Opening of ureter into pelvis.

seen. After careful inspection and the introduction of a bougie, supplemented by raising the pelvis, it was determined that the ureter was not connected with the most dependent part of the wall of the dilated pelvis, but, instead, with the posterior half, thereby causing the inner lip of the ureteral opening to act as a valve and close the aperture when fluid of "a slight or medium amount" was present in the pelvis. A greater degree of dilatation raised the valve and permitted fluid to escape. In order to overcome the valve formation, an incision of about a fifth of an inch in length was made vertically through the inner lip of the opening (Fig. 1073, *e*). The vertical incision was then changed to a horizontal direction by uniting the terminal points (Fig. 1074, *a*, *a'*) with fine silk sutures. A No. 11 French bougie was readily inserted through the opening down the ureter, and withdrawn only far enough to permit the upper end to protrude through the kidney wound (*x*), where it was retained until the wound had healed. The incision into the pelvis (*c*, *c*) was closed with ten fine silk interrupted sutures passed so as not to include the mucous lining. The kidney was then returned and nephropexy performed. The patient recovered without a fistula, and was cured of the cystonephrosis.

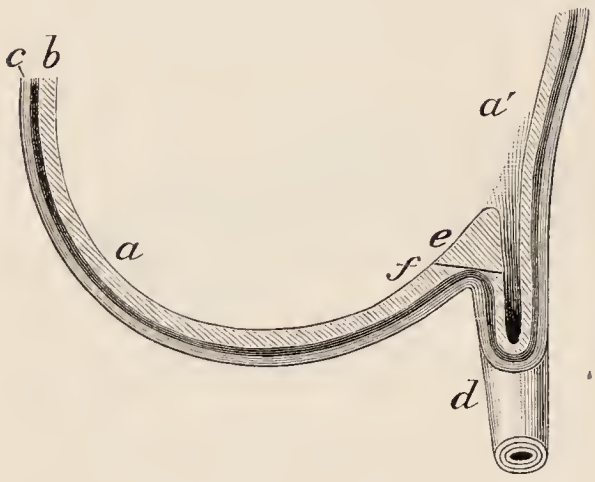



FIG. 1073.—Operation for cure of valve formation, Fenger's method. Dilated pelvis and the ureter. *a*, *a'*. The pelvis. *b*. The mucous membrane. *c*. The muscular and external coats. *d*. The ureter. *e*. The valve. *f*. Line of incision through valve.

In the second case, after isolation of the ureter from the sac wall to permit the opening within to be seen through the pelvic incision, a grooved director was inserted into the ureteral opening from within, and the portion of sac wall that encroached on the opening was resected all around, and the border of the ureter was sutured to the divided borders of the sac wall, thereby securing an ample opening for a free escape of fluids into the ureter. The exploratory opening was then closed, as in the preceding instance, leaving a small aperture for drainage. Gauze was packed around the tube down to the opening in the sac. The fistula closed on the fortieth day, and the patient made a complete recovery.

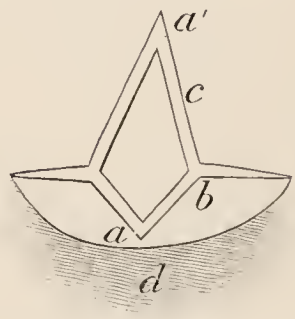



FIG. 1074.—Operation for cure of valve formation, Fenger's method. Valve seen from the pelvis, divided to illustrate operation. *b*. Opening of ureter. *c*. Divided valve. *d*. Inner wall of pelvis above opening of ureter. *a*, *a'*. Corners of incision to be untied by suture.

*Gerster*, in a case of this nature associated with traumatic hydronephrosis, approached the kidney and upper end of the ureter extraperitoneally through the oblique incision. The opening of the sac and evacuation of its contents exposed to view the renal end of the ureter surrounded by a *cone-shaped projection* about a third of an inch in height, formed by the eversion of the hyperæmic and thickened mucous membrane of the ureter (Fig. 1075). Under chloroform anæsthesia the rim of the

orifice was divided at either side, also at the middle of the upper border, downward, far enough to sever the structures completely at each line of division (Fig. 1076). The upper and lower angles of each incision were united together with catgut and the intervals closed transversely in a similar manner. The lower portion of the rim was then drawn downward by the influence of the apposition of the borders of an oval-shaped dissection located half an inch below the opening formed by the removal of a mucous flap a third of an inch wide and three quarters of an inch long. Thus the nipple-shaped structure was for the time being converted into a shallow funnel-shaped depression. An elastic catheter was introduced, but removed within twenty-four hours because of the pains produced in the bladder and penis. Under the influences of proper

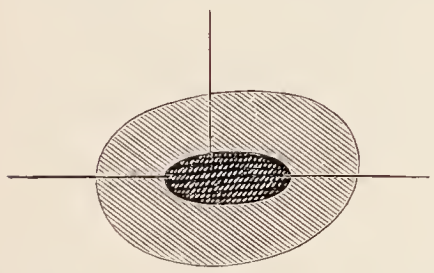


FIG. 1075.—Operation for cure of valve formation, Gerster's method. Cone-shaped projection surrounding renal end of ureter, divided at the sides and outer border.

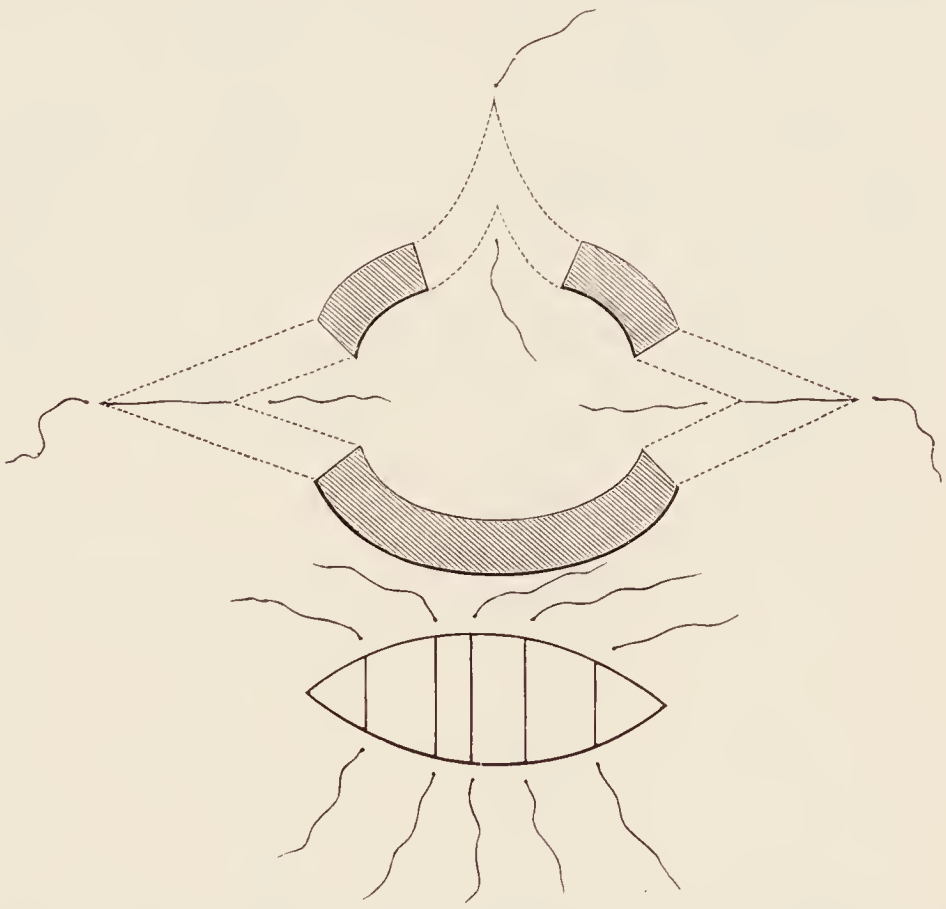


FIG. 1076.—Operation for cure of valve formation, Gerster's method. Points of division, the manner of approximation, and drawing down of lower lip shown.

cleansing and dressing, the wound was reported as healed five months afterward. About eight months later, however, the wound reappeared with evidences of return of the ureteral constriction.

*The Results.*—Five operations have been performed thus far, two of which (Fenger's and Mynter's) were successful.

**Stricture of the Ureter.**—Stricture of the upper abdominal portion of the ureter has been treated successfully by the following methods:

*Alsberg's Method.*—In a case of urinary fistula following a lumbar nephrotomy for hydronephrosis, Alsberg dilated from above with fine bougies a stricture at the upper end of the ureter. After several days urine entered the bladder, and some months later the fistula closed. The hydronephrosis did not recur.

*Kelly* practiced successfully from below the dilatation of a stricture of the lower end of the urethra.

*Fenger's Method.*—In a case of nephrotomy for increasing intermittent pyonephrosis of long standing, Fenger, failing to find the intrapelvic opening of the ureter, raised the kidney out of the wound and made a longitudi-

nal incision into the pelvis, not quite (Fig. 1077) an inch in length ($x$), drew the borders apart, and searched in vain for the opening of the ureter. The abdominal wound was then extended to within an inch of the anterior superior spine of the ilium, through which the upper end of the ureter was found to be bandlike in appearance, and imbedded for nearly half an inch in cicatricial tissue. A short longitudinal incision, of sufficient length to admit a probe, was made into the ureter, at a point about three fourths of an inch below its pelvic opening, through which a metal probe was easily passed down the ureter, but upward it encountered obstruction, because of a narrow stricture immediately above. The ureter was liberated at the constricted

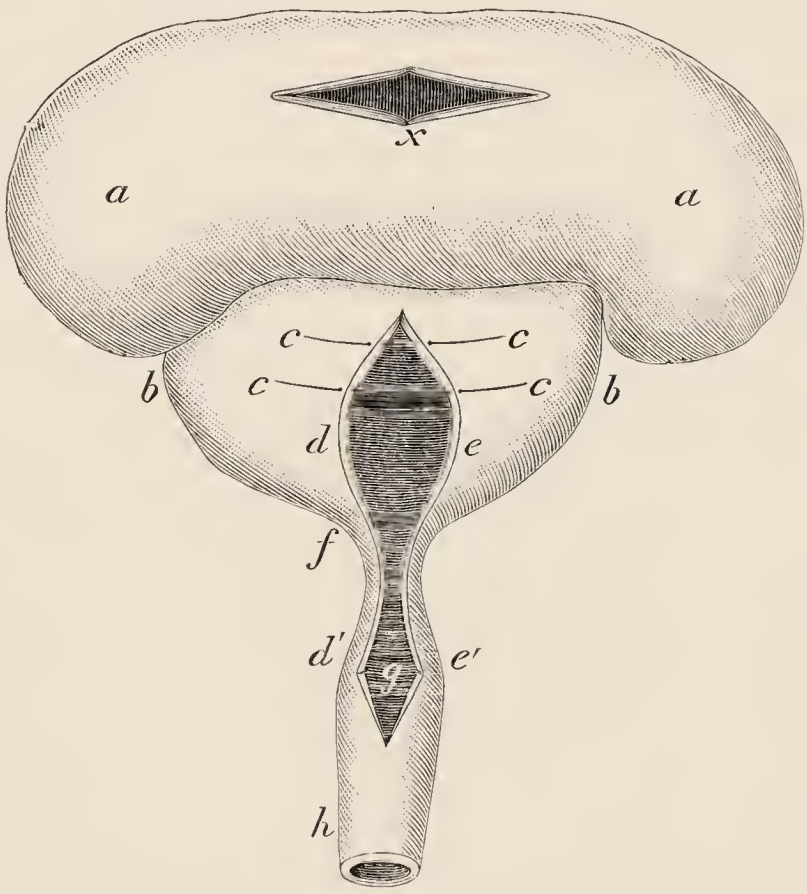



Fig. 1077.—Operation for cure of stricture of upper end of ureter, Fenger's method. *a*, *a*. The kidney. *x*. Nephrotomy opening. *b*, *b*. Dilated pelvis. *h*. Ureter below stricture. *f*. Stricture of upper end of ureter. *g*. Opening in ureter below stricture and extending through it into the pelvis. *c*, *c*, *c*, *c*. Sutures closing the upper half of the wound of the pelvis. *e*, *e'* and *d*, *d'*. Corresponding points of pelvis and ureter to be united by sutures after folding the ureter upon itself at the place of stricture.

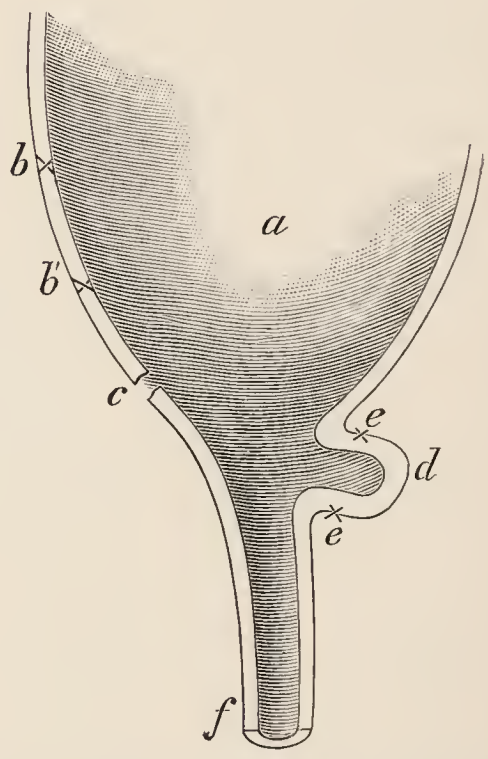



Fig. 1078.—Operation for cure of stricture of upper end of ureter, Fenger's method. *a*. The pelvis. *d*. Fold of ureter at place of stricture. *b*, *b'*. Sutures of wound in pelvis. *c*. Place of sutures between points *e*, *e'* and *d*, *d'* (Fig. 1077). *e*, *e*. Additional sutures needed to properly close borders of fold formed by approximations of *e*, *e'* and *d*, *d'*.

portion, and the stricture divided upward on the probe as a guide. The upper part of the wound in the pelvis was independently closed with sutures (*c*, *c* and *c*, *c*). The patency of the tube was then re-established by uniting the divided borders of the wall of the ureter to the corresponding borders of the pelvis (Fig. 1078, *d*). A large drainage tube was passed into the upper part of the kidney, and a small one down to the pelvis and ureter. Gauze strips were introduced at the anterior and posterior surfaces of the kidney, and for about three inches around the ureter. The abdominal wound was united, except at the lower portion, which was kept open for drainage. The patient made a happy recovery in all respects. In another case Fenger

practiced longitudinal ureterotomy at the upper end of the ureter, discovered and divided the stricture by a longitudinal incision, and repaired the wound by joining together the upper and lower ends with a suture, aided by folding the ureter on itself. The patient was cured.

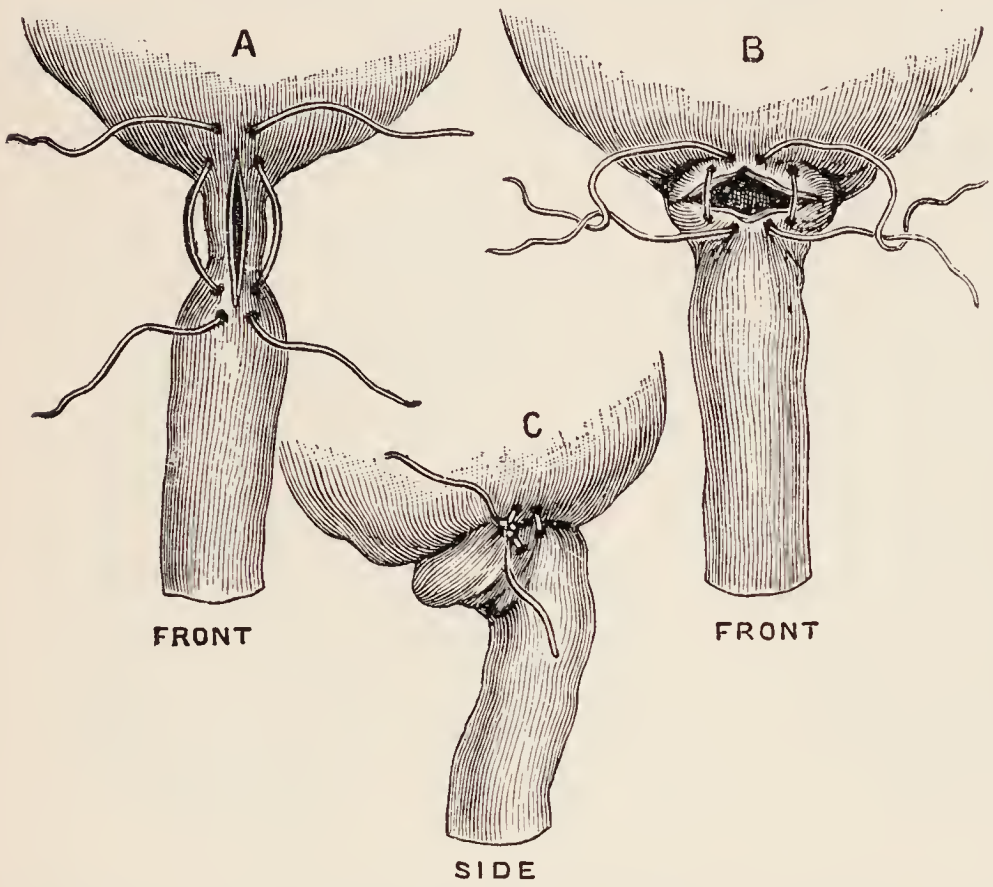



FIG. 1079.—Operation for cure of stricture of ureter, Morris's case. A. Stricture divided and sutures placed. B. Change of vertical to transverse direction by tightening sutures. C. Folding of the ureter from tying sutures.

*Morris*, after careful exploration of the calices and pelvis for stone, in a case of cystonephrosis, due to high stricture of the ureter, remedied the constriction as follows: He introduced a catheter through a small opening made into the infundibulum, and passed the instrument through the stricture into the bladder, then divided longitudinally the strictured portion upon the catheter. The longitudinal incision was then converted into transverse union by means of two fine silk sutures (Fig. 1079), thus curing the stricture. Closure of the exploratory parenchymatous incision, and immediate nephropexy, completed the operation. The wound healed by first intention, and the patient remained well at last report. Stricture of the ureter at a lower point may be cured by extraperitoneal longitudinal division, folding and sewing as in the preceding instances (Fig. 1080).

**The Resection of the Ureter for Stricture.**—In this procedure an inch or so of the tube is removed for stricture or other reasons, and the wound is repaired by restoration of the continuity of the duct. *Küster* first practiced the proposition in 1891.

*Küster's Method.*—After a lumbar fistula and vesical anuria, following a lumbo-nephrotomy, had existed for two years, Küster secured patency of the ureter in two months by the following plan: Failing to find the ureter through an extraperitoneal lumbar

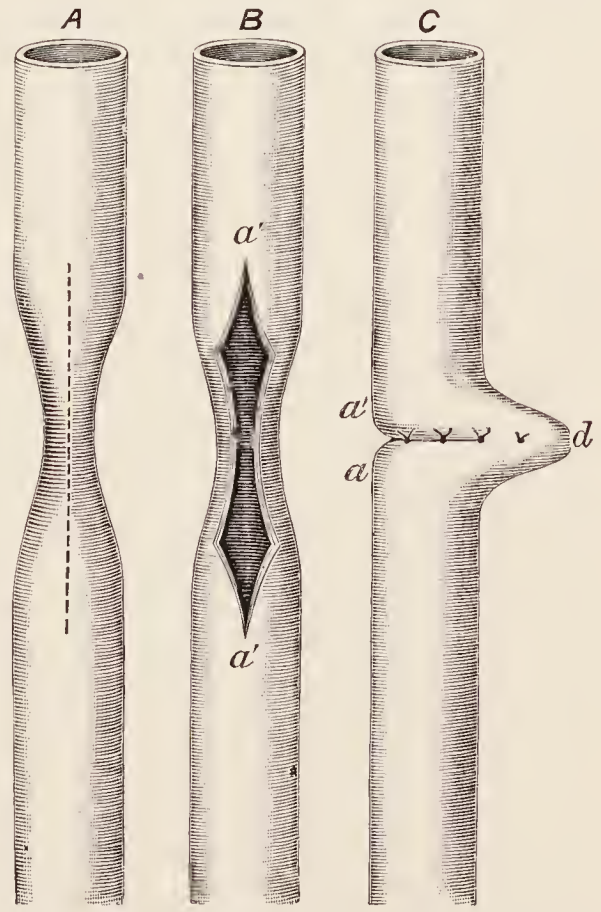



FIG. 1080.—Operation for cure of stricture of ureter, Fenger's method. A. Strictured ureter. B. Stricture divided. C. Extremities of incision (*a a'*) united. Ureter folded at *d*.

incision, he opened the pelvis of the kidney, disclosed the ureteral orifice, and with a probe located a stricture close to it. He divided the ureter transversely (Fig. 1081), just below the stricture and at the pelvic entrance, and closed the upper opening of the ureter and removed the fragment. He then slit up the ureter below at one side for a short distance ($x$), and introduced it through an incision made in the wall of the pelvis of the kidney, unfolded the end and sutured its borders to those of the opening in the pelvis (Fig. 1082), closing the remaining portion of the latter with sutures. The fistula closed at the end of four months and the patient recovered. Several successful resections have been reported since this of Küster's.




Fig. 1081.—Operation of resection of ureter for cure of stricture, Küster's method. $x$. Indicates line of division opening into transverse section of ureter.

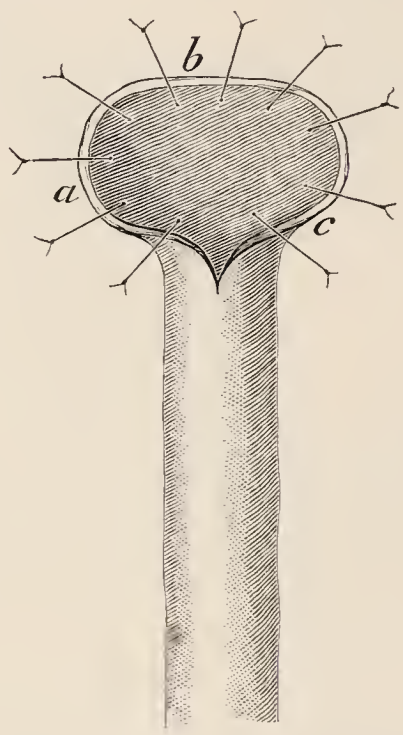



Fig. 1082.—Operation of resection of ureter for cure of stricture, Küster's method. End unfolded and sewed to opening in pelvis ($a$, $b$, $c$).

*Morris* reports a case of painful interrupted hydronephrosis dependent on oblique association of the ureter with a diseased renal pelvis (Fig. 1083). He first laid freely open the ureter and pelvis by a continuous longitudinal incision, and stitched together the corresponding borders of the respective parts. This, however, was not satisfactory, and he excised at once three quarters of an inch of the ureter, closed the greater part of the pelvic incision, and sutured the end of the ureter to the lowest part of the sac (Fig. 1084), after the manner of Küster (Fig. 1082). Then, fearing that the caliber of the opening would be much too small, and that the unfavorable condition of the patient and the extreme thinness of the wall of the ureter would lead to chronic fistula, the kidney was removed.

*The Remarks.*—Obstruction of the ureter from its abnormal connection with the pelvis of the kidney, because of kinking and compression at the pelvis by adventitious products and abnormal arrangement of vessels, is noted. For relief of the first cause of obstruction, transplantation of the ureter to a more suitable location of the pelvis, with or without resection of the tube, is practiced. For the last two, division of the constriction, without or with resection and implantation, is practiced.

The author offers no apology for introducing at this time the conclusions of *Van Hook* and *Fenger*. The logical results of their tireless labors, although modified by subsequent experience in many important respects, can not be

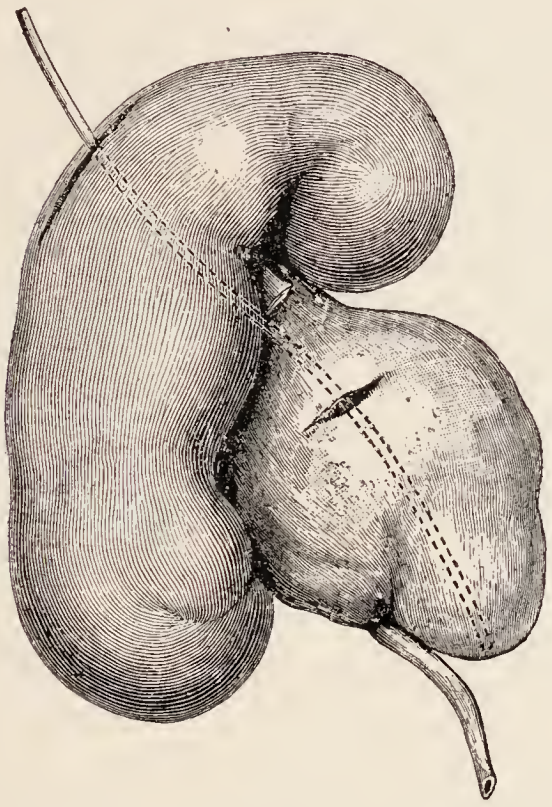


FIG. 1083.—Operation of resection of upper end of ureter, Morris's case. Showing opening into kidney substance and into the pelvis, and oblique association of ureter and dilated pelvis.

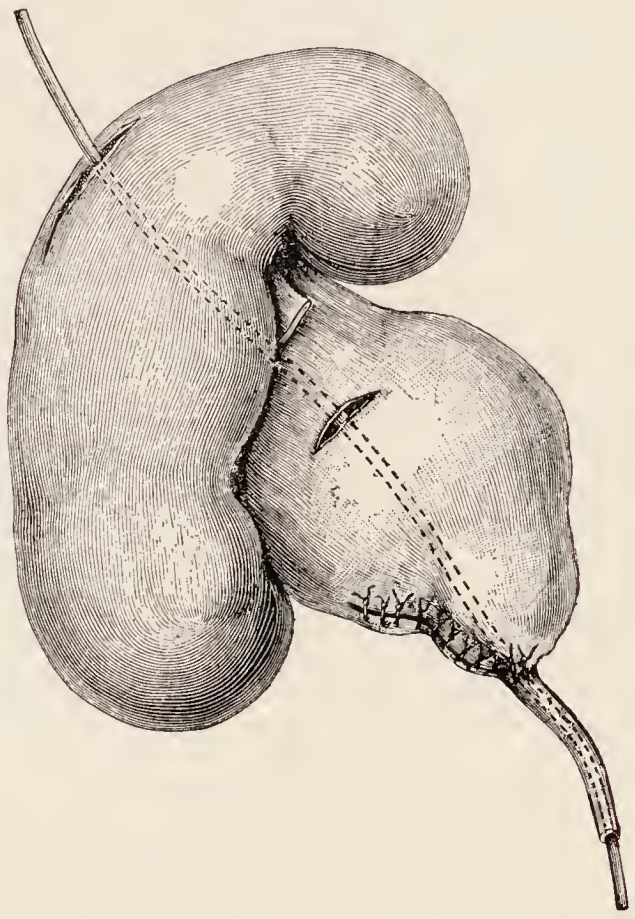


FIG. 1084.—Operation of resection of ureter, Morris's case. Side of pelvis sewed up and ureter attached to dependent portion.

exhibited too often as an earnest of commendable outcome and a stimulus to scientific endeavor.

**Conclusions of Van Hook.**—"1. The extrapelvic portion of the ureter is most readily and safely accessible for exploration and surgical treatment by the retroperitoneal route.

"2. Hence all operations upon the ureters above the crossing of the iliac arteries should be performed retroperitoneally, except in those cases in which the necessity for the ureteral operation arises during laparotomy.

"3. The intrapelvic portion may be reached by incision through the ventral wall, the bladder, the rectum, the vagina in the female, the perinæum in the male, or by Kraske's sacral method.

"4. The ureter is not only exceptionally well protected from injury, but by its elasticity and toughness resists violence to a remarkable degree.

"5. The histology of the ureters furnishes most favorable conditions for the healing of wounds.

"6. Longitudinal wounds of the ureter at any point heal without difficulty, in the absence of septic processes, under the influence of ample drainage.

"7. In all injuries where the urine is septic before the operation, or where the wound is infected during the operation, drainage must be effected.

"8. The chemic composition and reaction of the urine must be studied in

all injuries to the ureter, the urine being rendered acid, if possible, and the specific gravity kept low.

"9. The pelvis of the ureter is, *cæteris paribus*, the most favorable site for wounds of the ureter, since scar contraction is not so likely there to be productive of ill results.

"10. In aseptic longitudinal wounds of the ureter occurring in the course of laparotomy, suture may be practiced and the peritonæum protected by suture.

"11. Transverse wounds of the ureter involving less than one third of the circumference of the duct should be treated by free drainage (extraperitoneal) and not by suture.

"12. In transverse injuries in the continuity of the ureter, involving more than one third of the circumference of the duct, stricture by subsequent scar contraction should be anticipated by converting the transverse into a longitudinal wound and introducing longitudinal sutures.

"13. In complete transverse wounds of the ureter at the pelvis, sutures may be used if the line of union be made as great as possible.

"14. In complete transverse injuries of the ureter in continuity, union must not be attempted by suture.

"15. In complete transverse injuries of the ureter in continuity, union, without subsequent scar contraction, may be obtained by the writer's method of lateral implantation, as described (Fig. 1055).

"16. In complete transverse injuries of the ureter very near the bladder, the duct may be implanted, but with less advantage, into the bladder directly.

"17. At the pelvis of the ureter continuity, after complete transverse injury, may be restored by Küster's method (page 876) of suture, provided the severed ends can be approximated by slightly loosening the ureter from its attachments.

"18. *Rydygier's* method (page 866) of ureteroplasty in such injuries may be tried if other methods can not be utilized. The primary operation should at least fix the ends of the tube as nearly as possible together.

"19. In both transperitoneal and retroperitoneal operations the ureteral ends can be approximated by my method even after the loss of about an inch of its substance.

"20. The use of tubes of glass and other materials for the production of channels to do duty in place of destroyed ureteral substance must rarely be satisfactory, and, even if temporarily successful, the duct is almost sure to be choked by scar contraction.

"21. The implantation of the cut ends of a ureter into an isolated knuckle of bowel is objectionable: (1) Because the bowel is not aseptic; (2) because the operation is too dangerous.

"22. In injuries of the portion of the ureter within the pelvis, with loss of substance, the ureter should be treated as follows: If possible, the continuity of the ureter should be restored by the writer's method.

"23. If this is not possible, the ureter, if injured in vaginal operations, should be sutured to the base of the bladder with a covering of mucous

membrane as far forward as possible, with a view to a future implantation or formation of vesico-vaginal fistula with colpocleisis.

"24. In injuries to the pelvic ureter during laparotomy, where the continuity can not be restored, and where temporary vaginal implantation can not be effected in the female or vesical implantation in the male, the proximal extremity of the duct should be fastened to the skin at the nearest point to the bladder.

"25. In ventral ureteral fistulæ opening near the bladder, the ureteral extremity may, in some instances, be planted directly into the bladder without opening the peritonæum.

"26. In cases where the ureter will not reach the bladder, a flap may be raised from the anterior vesical wall and reflected upward, extraperitoneally, to meet the ureter and form a tubular diverticulum.

"27. Such a flap may be so elongated by a preliminary operation as to transplant the peritonæum back of the fundus, or by accurately suturing it there at a single sitting, that median ventral fistulæ of the ureter may be cured if they open at any point an inch or more below the umbilicus.

"28. Symphyseotomy is a valuable and justifiable preliminary step in these plastic vesical operations.

"29. It is legitimate when both ends of a cut ureter open upon the abdominal wall to try Rydygier's method.

"30. Implantation of one or both ureters into the rectum is absolutely unjustifiable under all circumstances, because: (1) The primary risk is too great; (2) there is great liability to stenosis of the duct at the point of implantation; (3) suppurative uretero-pyelonephritis is almost absolutely certain to occur, either immediately or after the lapse of months or years.

"31. Ligation of the ureter to cause atrophy of the kidney is unjustifiable.

"32. Extirpation of a normal kidney for injury or disease of the ureter is absolutely unjustifiable, except where the ureter can not be restored in one or other of the ways cited."

**Conclusions of Fenger** (1894).—"1. Accidental wounds and subcutaneous ruptures of the ureter have not as yet been objects of direct surgical procedure upon the ureter at the seat of lesion (eighteen cases since 1848 recovering). It will be advisable, however, when and as soon as the diagnosis can be made, or when lumbar opening of a peri-ureteral cavity containing extravasated urine is made, to look for the seat of rupture, and, if practicable, to restore the continuity of the canal.

"2. Catheterization of the ureters from the bladder for purposes of diagnosis of diseases of the kidneys has given valuable information affecting the decision for or against operation on the kidney.

"3. In man, catheterization is practicable only through epicystotomy. The danger of this operation is steadily decreasing.

"4. Catheterization of the ureter from the bladder as a curative measure for the evacuation of hydro- or pyonephrosis has occasionally been performed successfully. It is more difficult and more uncertain than nephrotomy and the attempt to find and remedy the stenosis of the ureter from the pelvis of the kidney.

"5. Dilatation of strictures of the ureter by elastic bougies or catheters has been tried from the bladder by Kelly with temporary success, and from the pelvis of the kidney by Alsberg successfully; consequently this procedure is of use in isolated cases.

"6. Permanent catheterization of the ureter from the bladder, a fistula, or an implanted ureter, is often tolerated only for a limited time, and must be employed with caution for fear of causing ureteritis.

"7. Uretero-lithotomy, longitudinal incision over a stone for its removal, is a safe operation by the extraperitoneal method. The wound heals without stenosis. In extraperitoneal operations suturing is unnecessary, drainage down to the wound being sufficient.

"8. Intraperitoneal ureterotomy should be done only when access outside of the peritoneal cavity is impossible, and it should be completed by careful suturing, covering with a peritoneal or omental flap and drainage.

"9. Opening of the peritoneal cavity to locate the seat of the stone may occasionally be necessary, but, when the diagnosis is once made, ureterotomy for the removal of the stone should be done through an extraperitoneal incision, and the abdomen closed.

"10. In valve formation or stricture of the ureter, causing pyo- or hydronephrosis or a permanent renal fistula, nephrotomy should be followed by exploration of the ureter in its entire course from the kidney to the bladder.

"11. Exploration of the ureter as to its permeability should be done from the renal wound by a long, flexible silver probe (a uterine probe) or an elastic bougie, either olive-pointed or not. If the bougie passes into the bladder the examination is at an end. The size of bougie that will pass through a healthy ureter is from nine to twelve, French scale.

"12. If the pelvic orifice of the ureter can not be found from the renal wound it should be sought for by opening the pelvis (pyelotomy), or by incising the ureter (ureterotomy).

"13. A longitudinal incision, half an inch to an inch long, in the posterior wall of the pelvis can be made while the kidney is lifted upward against the twelfth rib. This procedure is easy if the pelvis is dilated, but may be impossible if the pelvis is of normal size.

"14. Operation for valve formation should be done through the wound in the pelvis. If the opening can not be seen or found from the pelvis ureterotomy should be performed immediately below the pelvis. A small incision should be made in the ureter and a probe passed up into the pelvis. The valve should be split longitudinally and the incised borders so treated as to prevent reformation of the valve.

"15. A stricture in the ureter, if not too extensive, can be treated by a plastic operation on the plan of the Heinicke-Mikulicz operation for stenosis of the pylorus—namely, longitudinal division of the stricture and transverse union of the longitudinal wound. This method of operating for ureteral stricture seems to me preferable to resection of the strictured part of the ureter (Küster's operation) for the following reason: It is a more economical operation, and preferable when the elongation of the ureter is not sufficient

to permit the two cut ends of the ureter after excision of the stricture, not only to come in contact, but even to permit of closure and invagination without stretching.

"16. Resection of the upper end of the ureter and implantation of the distal end into the pelvis may be useful in rupture or division or stricture of the upper end of the ureter, as described by Küster.

"17. In a similar case of stricture in the upper end of the ureter, especially if the ureter were not elongated or the kidney movable, I should prefer the plastic operation proposed by me, as it is easier of technique, and as it proved successful in my case of traumatic stricture in the ureter below the pelvic orifice.

"18. The ureter is accessible through an extraperitoneal incision, from the twelfth rib down along and one inch anterior to the ilium and along Poupart's ligament to about its middle. This incision gives access to the upper three fourths of the ureter and down to within two or three inches above the bladder.

"19. The vesical and lower pelvic portions of the ureter may be reached, as Cabot has pointed out, by means of the sacral operation, or Kraske's method, modified by osteoplastic temporary resection of the sacrum. In woman the vesical portion of the ureter is accessible through the vagina.

"20. The vesical orifice of the ureter may be reached from within the bladder by suprapubic cystotomy in man, and by dilatation of the urethra, or suprapubic or vaginal cystotomy in woman.

"21. Uretero-uterine fistulæ can be treated satisfactorily by plastic closure of the vagina or by nephrectomy. Implantation of the ureter into the bladder is, under favorable circumstances, the operation of the future for this condition.

"22. Uretero-vaginal fistulæ and congenital urethral or vaginal terminations of the ureter should be treated by vaginal plastic operation for displacement of the proximal end of the ureter into the bladder. If these attempts fail, and the kidney is not infected, extra- or transperitoneal implantation into the bladder should be done, and finally, as a last resort, nephrectomy.

"23. Complete transverse wounds in the continuity of the ureter should be treated by uretero-ureterostomy after Van Hook's method of lateral implantation, if possible.

"24. Complete transverse wounds of the upper end of the ureter should be treated by implantation of the ureter into the pelvis of the kidney, as devised by Küster.

"25. Complete transverse wounds of the ureter near the bladder should be treated by implantation into that viscus either by splitting the ureter or by invagination.

"26. Loss of substance of the ureter too extensive to permit of uretero-ureterostomy, or too high up to permit of implantations into the bladder, may be treated by implantation on the skin or into the bowel.

"27. Implantation into the bowel is objectionable on account of the infection which is almost certain to follow sooner or later.

"28. Implantation into the rectum should not be resorted to when implantation into the bladder is possible.

"29. Implantation on the skin in the lumbar region, or the abdominal wall, may have to be followed by secondary nephrectomy, which, however, is much less dangerous than the primary operation."




FIG. 1085.—Instruments employed in catheterism of ureter in female.

*a*. Metal ureteral sound. *b*. Cystoscope with obturator removed. *c*. Cystoscope with obturator in place. *d*. Searcher. *e*. Applicator. *f*. Long forceps. *g*. Dilator of meatus and elastic ureteral catheter with stylet. *h*. Dentists' wax. A good natural or artificial light (Fig. 103) is of great importance in these examinations. Patient should be quiet when instrument is in ureter. An evacuator (Fig. 1088) is needed to remove fluid from around ureteral openings.

**The Catheterism of the Ureter.**—Catheterism of the ureter is now an accepted fact of practical importance. The introduction of a catheter or probe into the ureter for the purpose of diagnosticating the presence, nature, and situation of morbid conditions relating to the kidney and ureter, and their treatment, is an advance already assured, and soon bids fair to become a general established means of investigation and treatment. For anatomical reasons, the female patient has thus far reaped the greatest benefit from this advance.

*The technique of catheterism* of the ureter is quite complicated and difficult of utilization except by those amply fitted by experience and instrumental equipment for the purpose.

*The act of catheterism*, as practiced by Kelly, is effected in brief as follows: Cause the patient to empty the bladder while in the erect or sitting posture; place the patient on the table in knee-breast (Fig. 1086) or elevated-dorsal position (Fig. 1087); cause an assistant to separate and retain apart the buttocks and labia; cleanse the urethral orifice carefully with boric-acid solution; dilate the urethra cautiously; smear the end of the speculum with a sterilized oleaginous substance and apply the end of the instrument to the urethral opening and push it into the bladder with a gentle sweep beneath the pubic arch; withdraw the obturator with a slight rotary motion, noting the entrance of air and distention of the bladder on the withdrawal; adjust the head mirror and direct an assistant to hold the electric light so as to cause the reflected rays to fall within the bladder; inspect carefully the accessible walls of the organ by turning slowly the speculum in various directions; depress decidedly the instrument (knee-breast posture) to bring

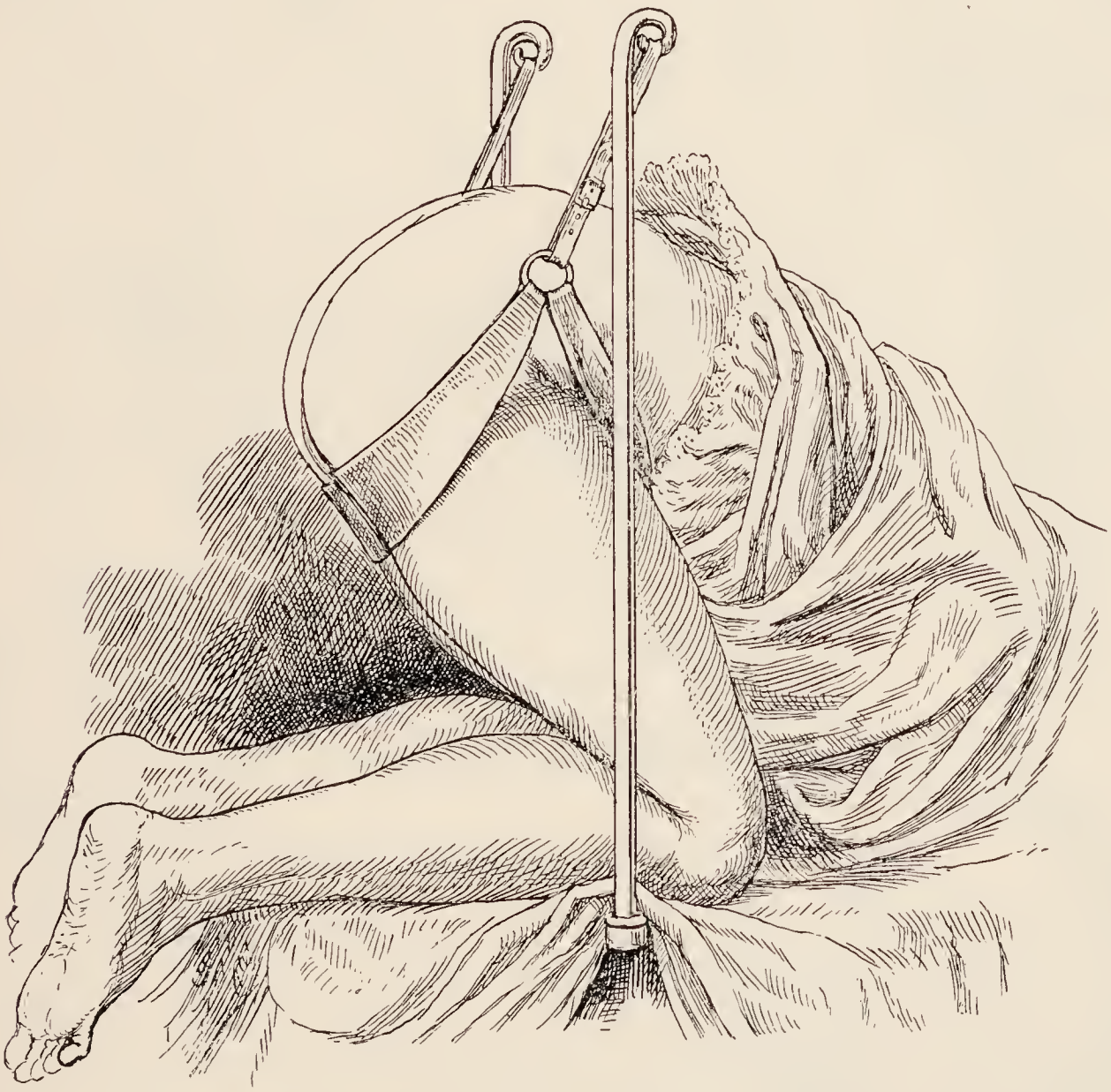


FIG. 1086.—The knee-breast position.

the vesical triangle into view, noting that this area is more deeply injected than are the mucous membranes elsewhere in the bladder; turn the speculum to the right or left about fifteen to twenty degrees, and observe the pink eminence denoting the position of the ureteral orifice; watch it for a brief

time (thirty seconds) to observe the ejection of urine; wipe the ureteral opening with aseptic cotton if the bladder or kidney be diseased; grasp the catheter, steadied with a stylet, and lubricate the extremity; introduce the extremity into the ureter and carefully push it up a little way; partially withdraw the stylet as the catheter is made to advance; push the latter upward into the pelvis of the kidney if desired; withdraw the speculum and retain the patient in position if the catheter is soon to be removed, if not, place her upon the side, carefully retaining the catheter in place during the change of posture. If the object of the introduction is to flush the pelvis of the kidney, the catheter should be small enough to permit a refluence along the outer surface of the instrument into the bladder, from which it may be caused to escape through a second catheter introduced through the

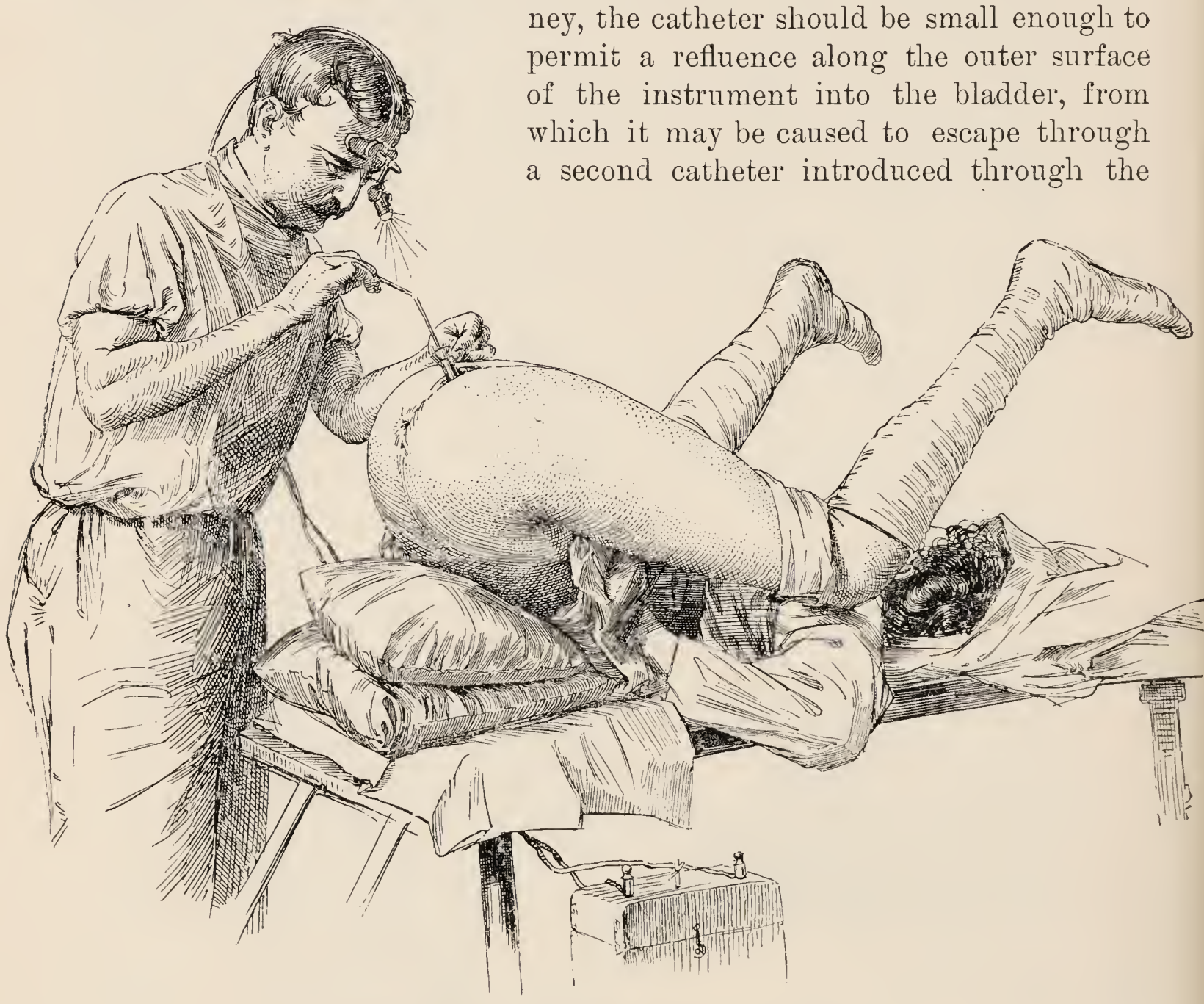


Fig. 1087.—The elevated dorsal position.

urethra by the side of the first. If the fluid introduced into the kidney be colored its escape from the bladder will then be convincing of the completeness of the circuit. If the condition of the kidney is to be determined by the characteristics of the urine, a metal catheter should be employed with a rubber-tube attachment to the outer end by means of which the urine can be collected. If at this time the bladder be thoroughly cleansed and completely emptied, the urine withdrawn from it thereafter will indicate the condition of the opposite kidney. The catheterization of both kidneys will enable one to determine the condition of either by the characteristics of the respective urines. If the ureter or kidney is to be sounded for stone a metal

instrument may be employed (Fig. 1085, *a*), or one tipped with wax, or with an extremity readily roughened by friction. Cases in which—because of weakness, great weight, or other cogent reasons—the restrained postures already described are not suitable for catheterism, *Kelly* introduces the catheter with the patient lying on the back and the thighs drawn upward. The bladder is emptied, the cystoscope introduced, the outer end strongly elevated, the inner turned to the right or left side of the base of the bladder, and the mucous membrane at the end of the speculum is examined for the opening. If it be not found at first the instrument is withdrawn to the neck of the bladder to determine its exact position. It is then pushed inward to one side, hoping to bring the orifice within the field. Sometimes it can be promptly accomplished in this way; again, it may be necessary to pass the end of the instrument lightly across the mucous membrane, and not infrequently the use of the searcher (*d*) is needed to detect the opening. One not thoroughly familiar with the practice need hardly expect to succeed under these circumstances.

*The Precautions.*—In catheterism of the ureter thorough asepsis should be practiced in all respects to prevent infection of the kidney. The urethra should be stretched carefully, so as not to cause needless dilatation and loss of power. The speculum should be introduced with relation to the curve of the arch of the pubis to avoid injury of the urethra. Careful introduction of instruments into the ureter and kidney is urged to prevent perforation of the former, and puncture of the latter, structure.

*The Remarks.*—If fluid obscures the ureteral orifice, withdraw it by means of the evacuator (Fig. 1088). A catheter may be kept in the ureter for several hours, and even for three or four days in some cases. Flexible instruments are the safer for use. Catheters employed in the kidney should be longer than those limited to the ureter. Wire stylets may be inserted or not in either case, depending on the stiffness of the catheters and the need for increased pressure in the introduction. Metal catheters are used when

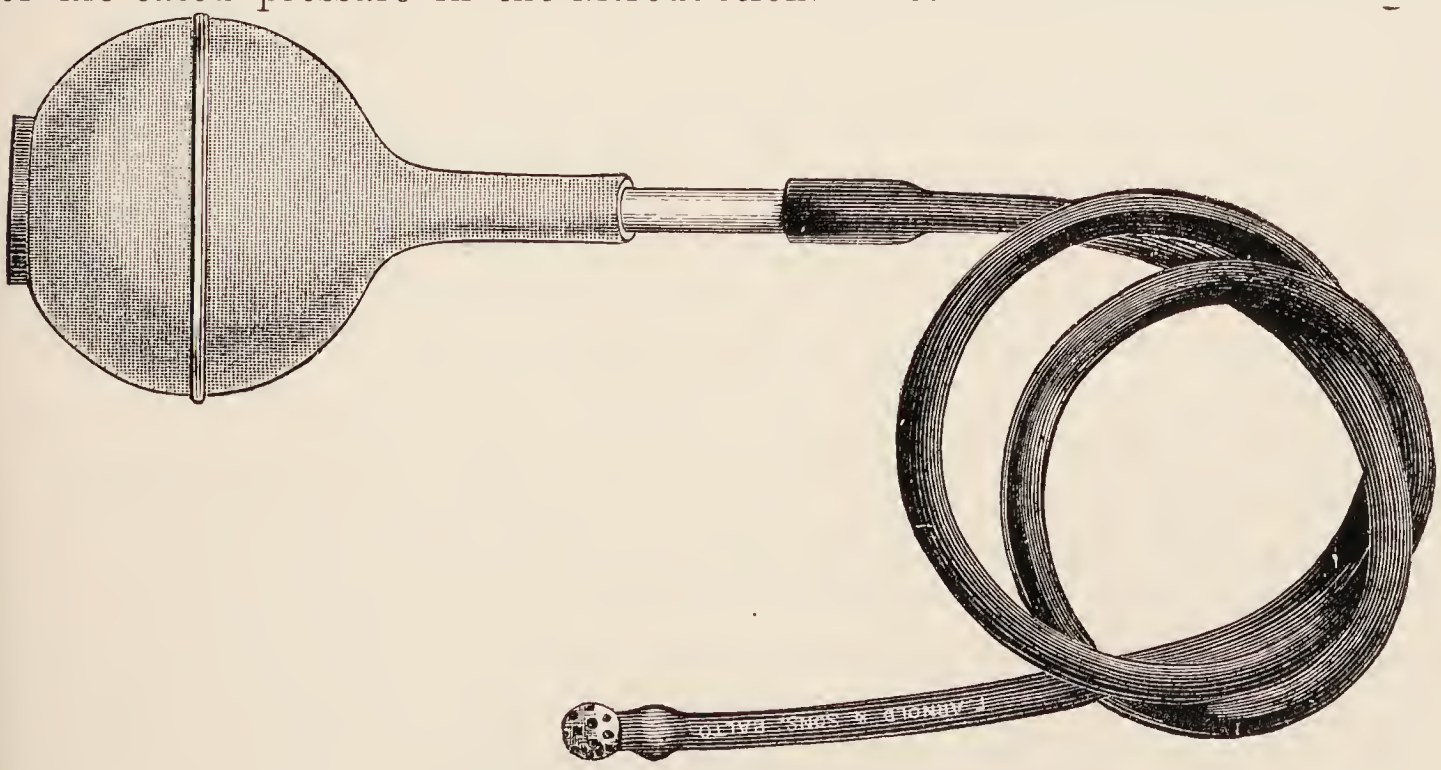


FIG. 1088.—The evacuator.

the canal is constricted or tortuous. Metal and hard-rubber bougies for dilatation are serviceable in those cases. If a bougie (with the tip covered with

dentists' wax, Fig. 1085, *h*) be pressed against a stone in the ureter or kidney the wax will bear evidence of the nature of the contact. The knee-breast posture is better than the elevated dorsal for stout patients.

*Kelly* uses boroglyceride solution to lubricate the instruments. An electric headlight (Fig. 103) is economic and advantageous in many instances. It frequently happens that the most cautious use of these instruments is followed by bleeding from the ureter. In very nervous patients, and at a first examination, general anæsthesia may be required. A four-per-cent cocain solution will deaden the sensibility of the urethra and bladder sufficiently for the purposes of the steps of the procedure.

Catheterism of the ureters in the female is quite easily accomplished by means of the ureter cystoscopes of Brenner, Casper, Nitze (page ), and others. But familiarity with their use is quite as essential to success as with the method of Kelly just described.

*Brown* has lately planned an instrument with a double-, instead of a single-barreled catheter attachment, by means of which modification he hopes to be able, in favorable cases, to catheterize both ureters at about the same time, and at least to introduce one or the other of the catheters, utilizing the remaining channel or barrel in regulating the amount and character of the fluid in the bladder, thus contributing at once to the success of the undertaking. Also he hopes to be able to siphon from the bladder with the disengaged catheter the fluid coming from the free ureter, and even, after raising the "intervening vesical ridge" from within the vagina or rectum, to separately siphon the fluids coming from the respective openings.

*Brown* reported * 55 instances of ureter catheterism without general anæsthesia, of which 28 were males and 27 females. In the great majority of these cases the Brenner instrument was employed.

Cocain anæsthesia contributes to the comfort of the patient, and correspondingly facilitates the conduct of the procedure. The presence in the bladder of a small amount of fluid is essential for the purpose.

In cases in which for any reason ureter catheterism is not available, a differentiation of the fluids may be sought by other means. The closure of one ureter by pressure variously applied, and of a ureter opening by similar means, the employment of suction at the vesical orifices (Fenwick), and the separation and collection of the fluids by special apparatus (Harris), are all ingenious, and each is effective in conformity with the period of its inception.

**Harris's Method.**—The method of Harris enables one to examine separately the unmixed urine of each kidney. Harris thus describes the instrument (Fig. 1089) devised by himself for the purpose: "It consists of a double catheter (*a*, *a*), each being separate throughout, but both being inclosed in a common sheath (*b*) throughout its shaft or straight portion, thus giving it the appearance of a single flattened tube. Each catheter is separately movable about its longitudinal axis within the sheath. On the flattened surfaces and the lateral portions of the semicircular surfaces are a number

* Annals of Surgery, December, 1899.

of small perforations. The distal extremity of each catheter is round and curved in the same plane as the proximal extremity, forming about a quadrant of a circle, the same as the curved end of an ordinary male sound. The curves of the two extremities being on the same plane, the distal end will always indicate accurately the exact direction of the proximal end. The distal extremity of each catheter is connected by means of a short piece of rubber tubing (*c*, *c*) with a separate glass vial. The corks of the vials are doubly perforated and each vial is finally connected by a piece of rubber tubing with a single rubber exhaust bulb (*d*). There is a metal lever (*e*)

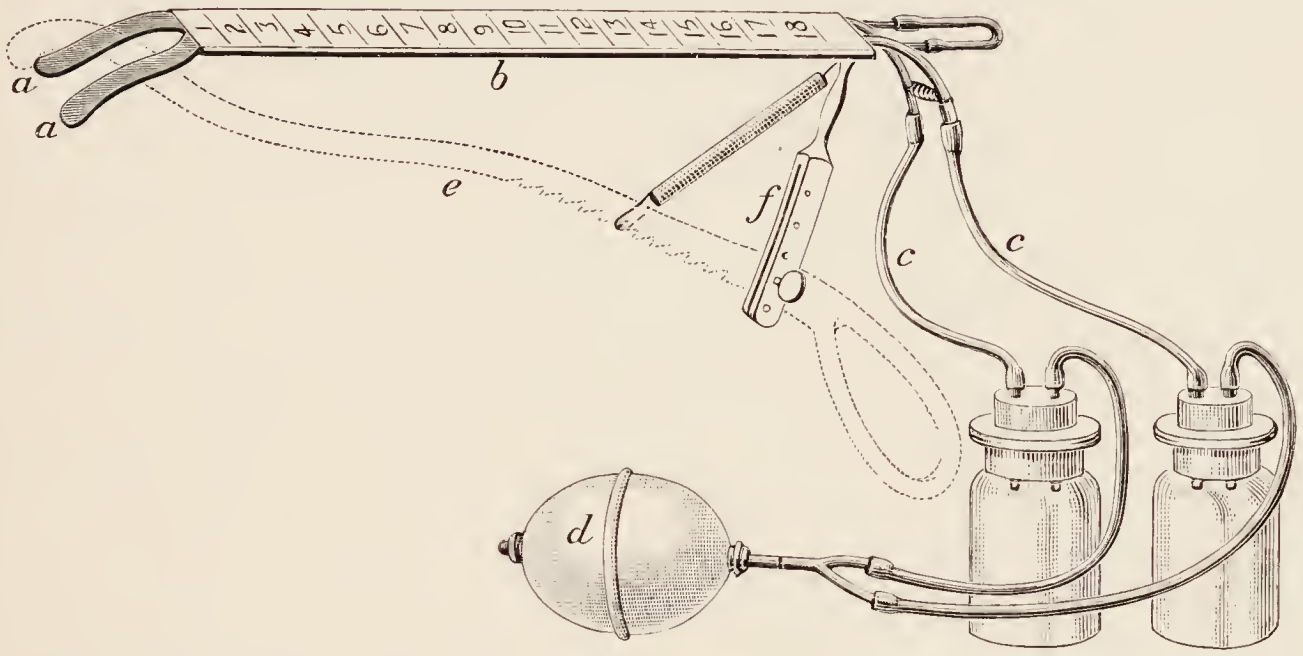



FIG. 1089.—The differentiation of urines, Harris's instrument. *a*, *a*. Double catheter. *b*. Common sheath. *c*, *c*. Rubber tubing connecting catheters with vials. *d*. Exhaust bulb. *e*. Metal lever. *f*. Fork connecting with the lever.

about eleven and a half inches long, with a handle at one end, the extremity being suitably curved and flattened, laterally. This lever is provided with a single perforation near the handle, is flattened at the sides, and notched along its lower border. A detachable curved forked metal piece connects the catheter with the lever when in use (*f*). This connecting piece is provided with a spiral spring arranged to catch in the notches on the under surface of the lever. The instrument is used in the following manner: The patient, male or female, is placed comfortably on a table in the ordinary lithotomy position, the hips being as high as the shoulders. The instrument with the flattened surfaces in contact, so as to form practically a single catheter, is introduced into the bladder in the ordinary manner. The connecting piece (*f*) is attached. The lever (*e*) passing through the forked connecting piece is now introduced into the vagina in the female, or the rectum in the male. The fork holds it in the midline. When introduced the proper distance, as indicated by the perforation in the lever coming opposite the perforations in the forked piece, it is fastened by passing the pin in the forked piece through the perforation in the lever. The instrument in the bladder is now opened by slowly and gently rotating each catheter about its longitudinal axis until each proximal end, as indicated by the distal, is directed outward and backward. The angle subtended posteriorly by the ends of the catheters should be about 100° to 110°. They are held in this

position by the small spiral spring. In opening this way, the end of the lever within the vagina or rectum passes up between the ends of the catheters, so as to form a septum extending longitudinally along the base of the bladder. The end of the lever is held snugly in between the diverging ends of the catheters by the spiral spring catching in the notches on the under surface of the lever. It will be seen now that the end of each catheter in the bladder occupies the bottom of a pocket, the pockets being separated by a perfect septum or watershed. The ureters open, one on either side of the watershed, near the base of the declivity in the immediate vicinity of the respective ends of the catheters. By producing a very slight exhaustion of the air in the vials by means of the bulb, the urine, as fast as it escapes from the ureters, drops directly into the ends of the catheters and flows at once into the vials, right and left respectively. Before attaching the vials to the catheters, the little pockets in the bladder may be thoroughly irrigated and cleansed, if thought desirable, by connecting an irrigator with the short, straight tip on the catheters, closing the other opening with the finger, thus washing through one catheter and out of the other." Cases are sometimes met with in which urinary differentiation can not be practiced.

It is proper to state at this time that the use of this instrument may be badly borne by the patient and be followed by annoying vesical irritation. If badly adjusted it may close a ureter.

*Downes* suggests a simpler apparatus for the purpose, for which he claims all of the merits and fewer of the discomforts that belong to the Harris apparatus.

## OPERATIONS ON THE SPLEEN.

The operations performed on the spleen are splenectomy, splenopexy, aspiration, and splenotomy.

*The Anatomical Points.*—The spleen lies between the fundus of the stomach and the diaphragm. The lower end reaches to the first lumbar spine; the upper to the ninth dorsal spine; the external surface corresponds to the ninth, tenth, and eleventh ribs. The inner end is distant about an inch and a half from the median plane of the body, and its outer end about reaches the midaxillary line (Quain). The long axis corresponds to the tenth rib. The peritonæum is reflected at the hilum, incloses the splenic vessels, and together they constitute the pedicle of the viscus, in a surgical sense. The suspensory ligament of the spleen is a double fold of peritonæum connecting the organ with the under surface of the diaphragm; the left crus of the diaphragm, the suprarenal capsule, and the flexure of the colon lie behind it. The splenic artery is large, tortuous, and gives off numerous branches near the hilum, some of which, the vasa brevia, pass backward to the stomach. These branches should be avoided in the ligature of the pedicle, if possible. The splenic vein is large and lies below the artery. These vessels are surrounded by a minimum amount of connective tissue, hence they are quite easily isolated and ligatured singly.

**Splenectomy.**—After thorough aseptic preparation of the patient, make an incision through the outer edge of the left rectus muscle down to the

peritonæum; push aside the intestines, expose the spleen and isolate it with broad flat sponges or wipers; ligature and divide the adhesions, also the gastro-splenic, the lieno-renal, and phrenico-splenic ligaments, carefully avoiding traction upon the latter; depress the parietes to lessen traction on the pedicle; commencing at the lower extremity, carefully expose and deliver the viscus; cautiously locate and secure the pedicle, either *en masse* or by separate ligature of the vessels; divide the pedicle with scissors or cautery, tying independently, perhaps, the open ends of the vessels for better security; remove the organ and drop the pedicle into the abdomen or attach it to the abdominal wound if secondary hæmorrhage be feared; wipe out the field of operation, carefully avoiding the pedicle; arrest the oozing, close the abdominal wound in the usual manner, unless otherwise indicated.

*The Precautions.*—As *Greig Smith* wisely said, "The success or failure of the operation may be truthfully said to depend on the treatment of the pedicle." A fatal outcome has often occurred in a few hours in the practice of the most skilled surgeons. It is difficult to lay down a hard-and-fast rule for treatment of the pedicle, since it so often varies in size, length, relation of the branches to the main trunk, etc. *Thornton* succeeded with two locked ligatures, supplemented by a single one surrounding the entire pedicle. The separate ligature of the important vessels is a reliable method, if the length of the pedicle and the relation of their branches to the proposed seat of ligature will permit. Double ligaturing should be practiced and the vessels divided between them when possible. The free use of clamps before ligaturing, and after, in advance of division of the pedicle, is a wise measure. *Greig Smith* advises the employment of pressure forceps in successive pairs, the division of the vessels between them, and ligature as the forceps are removed in turn. The vessels of the pedicle should invariably be tied while in a relaxed condition. Tension of the pedicle or twisting may prove fatal by causing shock or rupture of the vessels. Needlessly tight ligaturing is dangerous, because of the liability of the ligature to cut its way out.

*Jonnesco* and many other experienced surgeons regard with favor the incision at the linea alba (Fig. 963), supplemented if need be by a transverse one so located as to afford the most room and best opportunity for observation. The adhesions and serous ligaments should be divided between two ligatures to avoid the perplexities of oozing, and possibly a severer flow. Rough and careless efforts at separation of adhesions of the organ to contiguous structures may cause profuse bleeding from rupture of the capsule, requiring the use of the actual cautery, ligating *en masse*, etc., for arrest. Delivery of the organ from the abdominal wound should be made to the left or from below upward. The former best exposes to treatment the pedicle, which in either instance should not be made tense, and especially when the phrenico-splenic ligament is unsevered, as traction on this ligament appears to cause profound shock, possibly by interference with the respiratory function. A bleeding point is frequently noted on the left crus of the diaphragm.

*The Remarks.*—If the adhesions of the spleen are dense and extensive, removal of the organ should not be attempted. The posterior surface of the

pedicle may have become adherent to the tail of the pancreas, requiring care in separation, and possibly removal of part of the pancreas itself. Every preparatory precaution should be taken to anticipate and successfully treat the occurrence of shock. The dangers from secondary hæmorrhage require a careful arrest of all bleeding before the wound is closed.

*Partial resections* of the spleen are sometimes made for the purpose of *removal of innocent tumors and limited lacerations* with the view of avoiding the sequels that follow complete removal. The part of the organ to be removed is exposed and the portion of the gastro-splenic ligament corresponding to it is tied in sections between two ligatures and divided. The same part is then circumscribed with a continuous ligature of strong silk passed through in the following manner (Jordan): Arm a long needle with the ligature; pass the needle through the spleen from the under surface half an inch from the border, and draw the ligature upward until half its length appears above; carry the lower half upward around the lower border of the organ and tie firmly with the upper half at the seat of the needle puncture; pass the needle through the spleen within an eighth of an inch of the outer side of the turn close to the ligature; repass the needle from the under surface upward through the organ half an inch farther along and tie as before the included portion; repeat these steps until the line of proposed occlusion is traversed, finally tying the ends over the border of the spleen in a reef knot; excise the tied-off portion, cauterize any oozing points that may appear, cleanse the wound, and close the abdominal wound. This plan is certainly more secure than that of transfixion pins and elastic ligatures combined with cautery.

*The Results.*—In 28 cases of splenectomy for leucæmia, 25 died from the immediate effects of the operation, 20 of which occurred in the first 12 hours from hæmorrhage. Twelve deaths followed 29 operations for hypertrophy due to malaria; in 43 cases done for simple hypertrophy and wandering spleen, the death rate was 20 per cent; 18 to 40 per cent when practiced for cysts, and 25 to 30 per cent for malignant disease. The removal of large tumors is especially fatal. Later estimates make the rate less than 15 per cent.

**Splenopexy.**—Splenopexy is the fixation of the spleen to some part of the abdominal wall. It is sometimes practiced to secure relief and avoid at the same time the high rate of mortality that attends the removal of the organ. *Rydygier* introduced the operation, and reported a successful case in 1895. He entered the abdomen at the median line by a vertical incision, raised the spleen upward to a proper point for fixation, and detached sufficient parietal peritonæum to form a retentive pocket. The peritonæum was divided transversely with an upward convexity and detached from above downward to a sufficient dimension to provide a pocket for the reception of the lower half of the spleen. To prevent further detachment of the peritonæum, it was sewed to the underlying structures around the limits of its separation. The spleen was placed in the pocket, the border of which was sutured to the gastro-splenic omentum which lay above it.

*Bardenhauer* placed the spleen practically outside the peritoneal cavity in the following manner: He made a vertical incision between the ribs and

iliac crest, and joined to it a transverse one carried along the lower border of tenth rib. He detached the flap thus outlined down to the peritonæum and held it aside while an opening was made through the latter large enough to admit the spleen by its smallest diameter. The spleen was then drawn through the peritoneal opening, the border of which was drawn closely around the pedicle by means of a purse-string suture. A strong suture of silk was then passed under the spleen's end and above over the tenth rib, so as to form a retentive sling for the spleen. Additional strengthening sutures were applied at suitable sites and the flap was replaced and sutured.

*Zykow* has conceived the idea, based on animal experimentation, of establishing fixation by means of a network of catgut carried round the organ and fastened by its ends to the abdominal wall, the idea being that the cicatricial tissue that replaces the catgut will hold the organ in position. Contraction of the spleen seems to have followed this practice in animals.

*The Results.*—This operation is a safer procedure than splenectomy, but, unfortunately, is not always permanent.

**Aspiration of the spleen and splenotomy** are rarely done. The former is a hazardous procedure and should not be practiced. The danger from sepsis and hæmorrhage is comparatively great, in view of the apparent simplicity of the act. *The death rate* from aspiration of cysts only is from 18 to 49 per cent.

**Splenotomy** consists in opening into the spleen below the ribs to reach a cyst or abscess for evacuation and treatment by the open method. The danger of peritoneal infection in septic cases in the absence of adhesions is evident. Therefore, adhesion should be secured if possible; if not, careful packing with gauze should precede the incision of the spleen. After exposure of the spleen, aspiration should precede incision, which latter is freely made, and the cavity drained with gauze. If necessary the entrance can, with proper precautions, be made between the ribs.

## OPERATIONS ON THE PANCREAS.

The great depth of the pancreas, and its intimate and important environments, have made extended operations on the viscus dangerous and of somewhat doubtful utility. Improved technique and a better understanding of the nature of its morbid processes have lessened the dangers, but not sufficiently to disarm in the least the greatest caution in operative procedures.

*The Anatomical Points.*—The pancreas lies deeply in the abdomen, the anterior surface is in contact with the stomach, and the central part of the inferior surface is covered with the lower layer of the transverse mesocolon. The posterior surface is separated from the spine by the aorta, vena cava, superior mesenteric vessels, and crura of the diaphragm. The head of the organ is embraced by the duodenum and the tail lies in contact with the spleen. It is in relation with the portal vein behind, toward the right extremity. At the upper border and at the posterior surface lie the splenic artery and vein. The common bile duct lies closely behind the head of the pancreas and is sometimes imbedded in its structure. The blood supply of the organ comes from the splenic, pancreatico-duodenal, and the superior

mesenteric arteries. But little of established practical importance is yet determined in the surgery of the pancreas, except the operation for cysts.

*The Operation for Pancreatic Cyst.*—Make a short, straight, vertical incision in the median line down upon the tumor and arrest hæmorrhage. *If adhesions be present*, respect them, and remove much of the contents of the cyst with an aspirating trocar; incise the cyst, evacuate the remaining contents, stitch the edges of the incision to the borders of the abdominal wound, and introduce a drainage tube. *If adhesions be not present*, carefully incise and draw aside the overlying omentum and ligature the bleeding points; introduce the aspirating trocar and remove enough of the fluid to relax the walls of the cyst, which are then seized with catch forceps and drawn well forward into the abdominal wound; turn the patient to one side and incise the cyst wall sufficiently to admit a large drainage tube, after which the borders of the cyst are sewed to the abdominal incision.

The amount of fluid subsequently discharged is often great, requiring careful oiling of the surface and also frequent changing of the dressings to prevent irritation. The tube is shortened from time to time, and the size lessened as shrinkage of the sac takes place.

*The Remarks.*—The abdominal incision is sometimes made over the most prominent point of the tumor, in the belief that it will correspond more nearly to the seat of the exciting cause. *Leith* advises a posterior incision at the left side, under the twelfth rib, through which the fingers along the outer border of the quadratus lumborum seek the kidney and tail of the pancreas. Here the lesser peritoneal cavity can be entered through the mesocolon or peritonæum. Exploratory puncture can be practiced for diagnostic purposes, but with the danger of leakage and peritonitis, and also of injury of contiguous structures. The aspiration treatment is not only dangerous but ineffective, as the fluid rapidly reaccumulates. Extirpation of the cyst ought not to be attempted except for some weighty reason, but unhealthy isolated parts of the cyst wall should be removed when practicable, provided their loss does not require that undue traction be made to join the borders to the abdominal opening. If there be good reason for the act, preliminary incision with gauze packing can be practiced to insure serous union before evacuation of the contents.

*The Results.*—In incision and drainage the results of the operation are exceedingly favorable—i. e., 65 cases with 7 deaths. Cases with a pedicle are often extirpated unless pancreatic tissue be spread upon the surface; 113 have been thus treated, of which 11 recovered.

Further indications for operation are given by *Senn*, to whom the profession is largely indebted for the development of surgery of the pancreas.

"Partial excision of the splenic portion of the pancreas is indicated in cases of circumscribed abscess and malignant tumors, and in all cases where the pathological product can be removed completely without danger of compromising pancreatic digestion or inflicting abdominal injury upon important adjacent organs.

"Ligation of the pancreas at a point or points of section should precede

extirpation as a prophylactic measure against troublesome hæmorrhage and extravasation of pancreatic juice into the peritoneal cavity.

"The formation of an external pancreatic fistula by abdominal section is indicated in the treatment of cysts, abscesses, gangrene, and hæmorrhage of the pancreas due to local causes.

"Abdominal section and lumbar drainage are indicated in cases of abscess or gangrene of the pancreas where it is found impossible to establish an anterior abdominal fistula.

"Thorough drainage is indicated in cases of abscess and gangrene of the pancreas with diffuse burrowing of pus in the retroperitoneal space.

"Removal of an impacted pancreatic calculus in the duodenal extremity of the duct of Wirsung, by taxis, or excision and extraction, should be practiced in all cases where the common bile duct is compressed or obstructed by the calculus and death is threatened by cholæmia."

It is proper to say that much time and greater experience will be needed to demonstrate the utility of many of these indications.

**Subphrenic Abscess.**—The expression, subphrenic abscess, is applied to a collection of pus of greater or lesser extent located immediately beneath the diaphragm at either side. A subphrenic abscess may be extraperitoneal or intraperitoneal according to the relations of the serosa at the seat of pus collection. These abscesses arise from various causes, and nearly half of them are the result of lesions of the stomach, duodenum, cæcum, appendix, liver, and biliary passages, and in the order mentioned. *Aspiration and incision* are the plans of treatment employed. Aspiration as a means of treatment needs only to be mentioned that it may be the more forcibly condemned, for the attempt to cure by this procedure is quite hopeless and should not be tried. Aspiration only for diagnostic purposes is admissible. Abdominal incision, or the thoracic incision with or without rib resection, can be practiced, according to the demands of the case.

*The Abdominal Incision.*—The abdominal incision is made at the epigastric, hypochondriac, iliac, or lumbar region, as may suit best the demands of safe approach to the abscess and the requirements of subsequent drainage. In any one of these incisions the technique of approach and entrance to the abscess contemplates the steps preventing infection and the securing of ample drainage, as in abscess elsewhere in the peritoneal cavity.

*The Operation.*—After proper aseptic preparation the incision is usually made at the most prominent part of the tumor, or at the point nearest to the pus, through the respective tissues down to the abscess. If adhesions be present, the opening of the abscess and the evacuation of its contents, though simple matters, should be carefully conducted. The serous membrane should be shut out of the operation field with a gauze tamponade before the abscess is incised; and even when properly done subsequent changes in the relation of the parts, due to liberation of the pus, movements of the patient, and the natural disadvantages of prolonged drainage and its bad influence, expose the patient to manifold dangers. In all anterior incisions a more dependent drainage than the primary incision offers should be established, if possible. In the absence of ability to arrange this provision

large drainage tubes should be introduced and the discharge facilitated by the position of the patient when expedient. The accepted local treatment for abscess repair at other situations is practiced in these with such variation as circumstances may require. If the abscess be accessible to the lumbar incision for exposure of the kidney, or to the incision for removal of the appendix vermiformis, then, indeed, the technique of approach and subsequent drainage differs from these operations in no essential regard. It is obvious at once that these are the most satisfactory of all the abdominal incisions, and should be practiced when feasible.

*The Thoracic Incision* (*Midaxillary Line*).—The thoracic incision is commonly made across, but sometimes anteriorly to the midaxillary line. The technique is substantially similar in each instance. After thorough aseptic care, place the patient on the back near to the side of the table; administer chloroform or ether as the indications suggest; *make an incision across the midaxillary line* three or four inches in length parallel with and down to the selected rib; expose and resect the rib as in empyema (Fig. 1248); incise the costal pleura; pack the borders of the wound with gauze to prevent pleuritic infection; if pus be not present there, ascertain with the needle its situation; liberate the pus by separating the tissues along the course of the needle with forceps or blunt scissors; interrupt the flow occasionally with a sponge to prevent unpleasant symptoms; introduce the finger or a spoon into the abscess and remove necrosed tissue if the condition of the patient will permit; arrest hæmorrhage, and cleanse the cavity with hot saline, or with the bichloride solutions if offensive; stitch the edges of the diaphragmatic opening to the skin if practicable; pack the abscess cavity with gauze if it is small, introduce a three-quarters-of-an-inch drainage tube if it is capacious; cover with abundant gauze held in position with a binder, and cause the patient to lie on the affected side. Irrigation of the abscess cavity is avoided and the tube shortened to keep pace with its

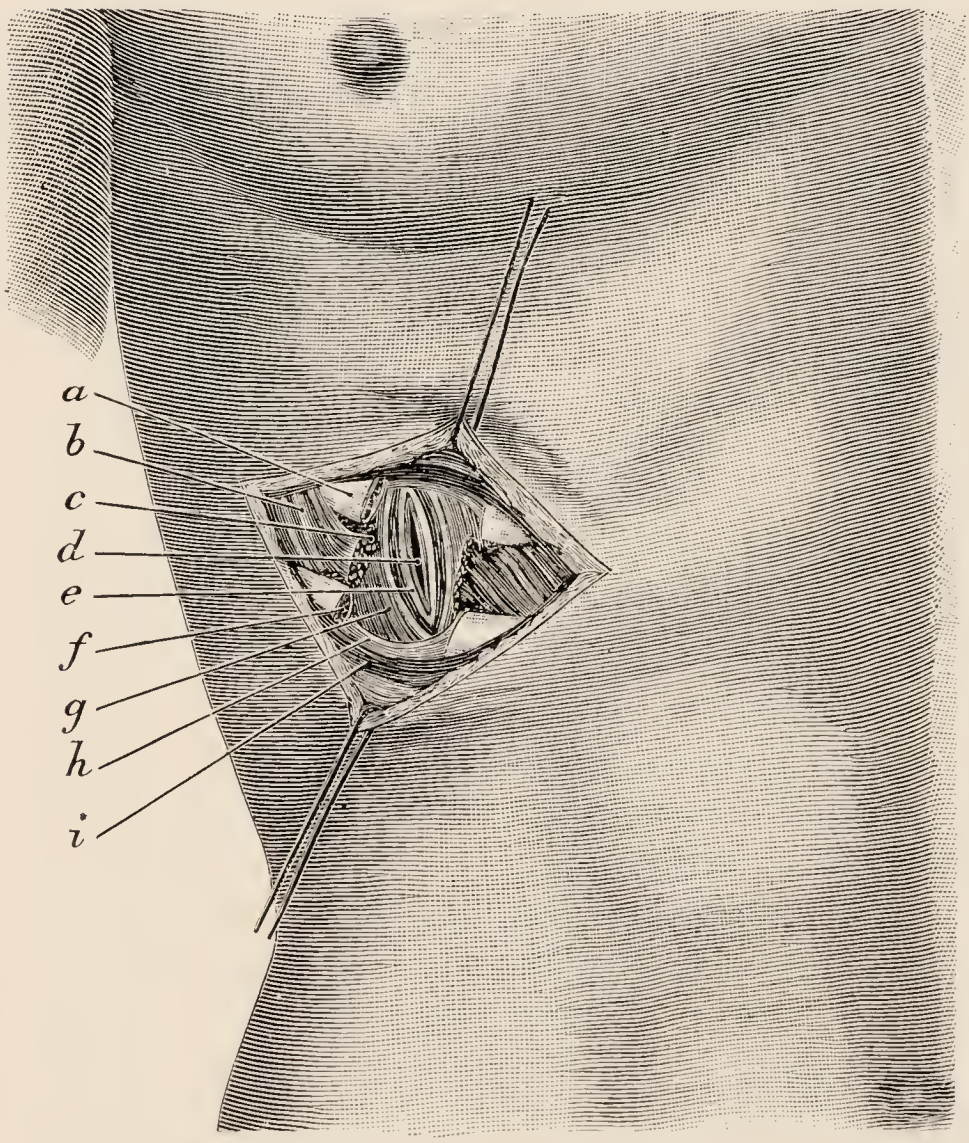



FIG. 1090.—Operation for exposure of subdiaphragmatic space and of liver anteriorly to the midaxillary line. *a*. Seventh rib. *b*. External intercostal muscle. *c*. Intercostal vessels and nerve. *d*. Liver. *e*. Peritonæum. *f*. Eighth rib. *g*. Diaphragm. *h*. Parietal pleura. *i*. External oblique muscle.

healing. *If excision be made anteriorly to the midaxillary line*, the incision is commonly located between the seventh and eighth ribs, portions of one or both of which may be removed. Carry the incision obliquely forward between the ribs (Fig. 1090); expose and divide the external oblique muscle, detaching it from the ribs; resect portions of one or more of the exposed ribs and the intervening soft parts, ligaturing the vessels at either end; expose and dissect off the thin intrathoracic fascia, uncovering the pleura; press together and unite with sutures the layers of pleura, if haste is required, if not, divide the outer layer and pack the wound to cause adhesions, and then later resume by dividing the inferior layer, thus revealing the diaphragm; observe that its fibers run downward and forward; separate and draw them apart, disclosing the parietal peritonæum as it rests on the convex surface of the liver. If the operation be for abscess or hydatid cyst of the liver, open with trocar, cautery, or knife at once if adhesions be present, if not, and time will permit, pack the wound and open two or three days later. If the case be urgent, sew together the parietal and visceral layers of peritonæum and open immediately, as before. If subphrenic abscess be the object of the operation, open the abdomen at once; otherwise the methods are alike. *Lange*, instead of dividing the pleura, goes under it by peeling it off the diaphragm.

If pus be present in the pleural cavity it is evacuated, and the subphrenic collection liberated and removed the same as before.

*The Comments.*—Pyothorax and subphrenic abscess are frequently associated, the former being a sequel to the latter. The proper seat of operation is established best by the aspirating needle, which is employed as well during the operation for the better localization of the pus. Either the eighth, ninth, or tenth rib is selected for incision, as a rule—the highest of the three in complicating empyæma, the lowest in subphrenic abscess alone. In subphrenic abscess the lumbar and iliac routes are the best ones; the lateral thoracic is next in order; the anterior thoracic and abdominal the most objectionable of all. The location of the origin and the extent of the abscess usually determine the availability of the respective routes.

*The Results.*—The earlier the diagnosis, the more favorable is the outcome of the case. Spontaneous healing is rare, occurring in less than 6 per cent of the cases. The death rate is estimated from 50 (Maydl) to 82.5 per cent (Scheurlen). However, an early diagnosis, followed by prompt treatment with improved technique, will no doubt produce greatly improved results.

**Paracentesis Abdominis.**—Paracentesis abdominis is an operation employed to remove fluids from the peritoneal cavity. It should be recognized at the outset that the procedure is not entirely devoid of danger. Aspirators and trocar and cannula are each employed for the purpose.

The abdominal wall should be thoroughly cleansed in advance of the operation, and be protected with gauze. The strength and fortitude of the patient to meet the requirements of the operation should be carefully estimated in advance, and the forces fortified with the necessary stimulants. The agent of puncture should be thoroughly smooth, sharp, and aseptic before introduction. The bladder and rectum should be empty, and the

abnormal line of dullness of the abdomen carefully determined by percussion immediately before the puncture is made. The belly of the patient is then surrounded by a broad, many-tailed bandage, having a small opening in the center corresponding to the point of proposed puncture. If unable to sit, the patient is caused to lie upon the side near to the edge of the bed. If the condition of the patient will permit, he may be placed in an ordinary chair with the body bent forward and the head and arms resting on the back of a chair placed in front. If a small rocking chair be employed for this purpose, the patient can be easily and quickly tipped backward into the recumbent position if syncope be imminent during the removal of the fluid. The injection of a weak solution of cocain at the seat of operation will meet the full anæsthetic demands of the act (Fig. 1091).

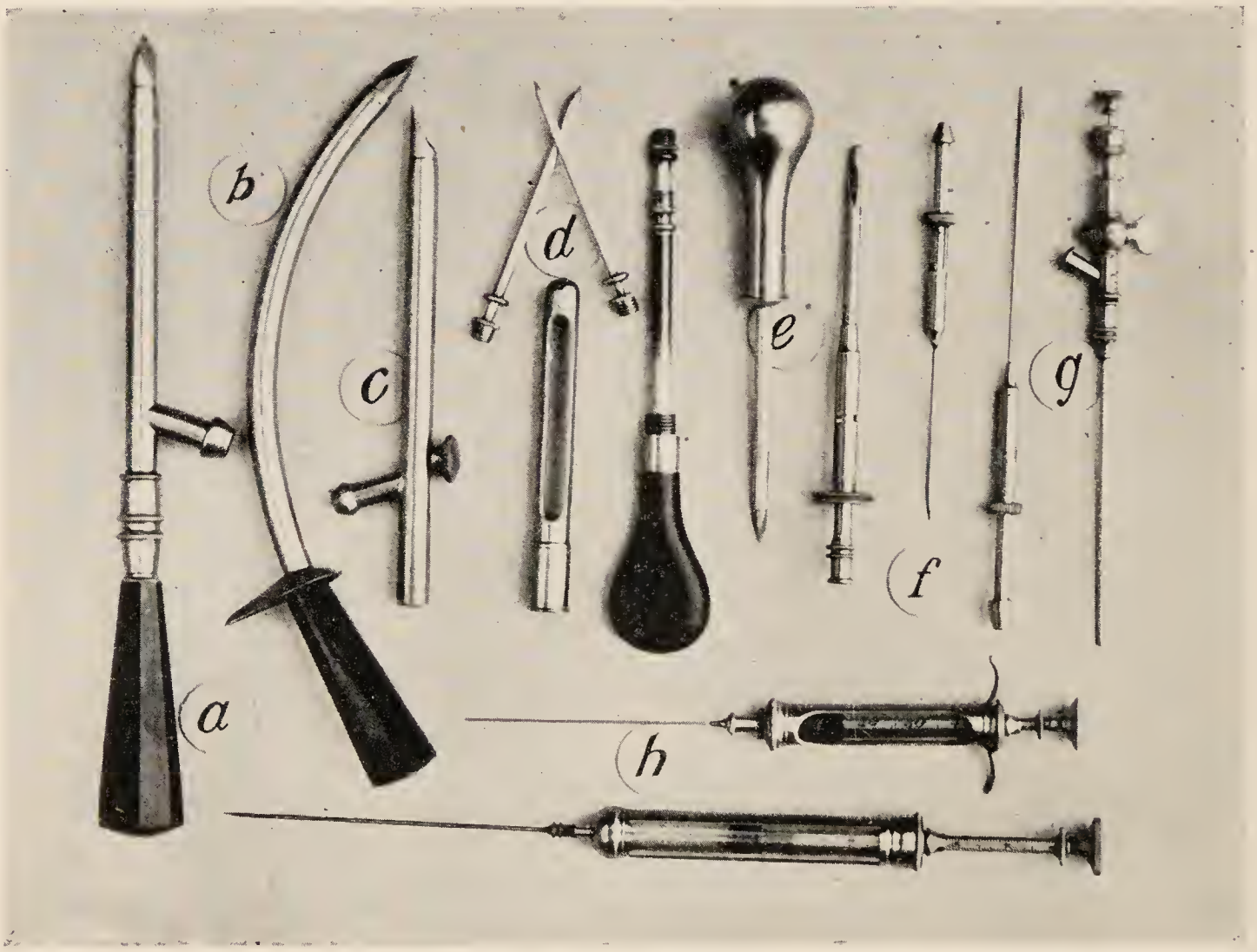



FIG. 1091.—Instruments employed in paracentesis abdominis, thoracentesis, tapping pericardium, etc.

*a*. Emmet's trocar. *b*. Rectal trocar. *c*. Duncan's trocar. *d*. Nest of trocars, assorted sizes. *e*. Common trocar. *f*. Fitch's aspirating protected pointed trocars, assorted sizes. *g*. Billroth's aspirating trocar. *h*. Aspirating syringes. Other forms of aspirators may be employed. Figs. 1093 and 1246.

*The Operation.*—Carefully localize the proper seat of puncture by percussion, and estimate the thickness of the abdominal wall; adjust the slit in the bandage to correspond to the point of introduction; seize the instrument firmly with the index finger so placed on the upper surface as to limit the extent of the introduction (Fig. 1092); push the instrument quickly into the abdomen and withdraw the trocar, leaving the cannula in place; tighten the bandage as the fluid escapes, to facilitate the flow and support the

patient; remove the cannula as soon as the fluid has escaped, and when syncope is impending and further withdrawal at this time is impracticable; close the puncture with an interrupted deep suture of catgut, and dress the part with gauze held in place with a bandage.



Fig. 1092.—The operation of paracentesis abdominis with trocar.

*The Precautions.* — Carefully avoid puncture of a distended bladder or uterus and of a displaced or enlarged viscus. If the puncture be made too near the line of dullness, or the instrument be misdirected, the intestines may be wounded. Carefully avoid puncture of the abdominal wall at the established site of significant blood-vessels. The plugging of the needle or cannula by fibrin is relieved by the introduction of a probe, causing dislodgment of the obstruction. As the fluid escapes, the intra-abdominal end of the instrument should be so changed in its direction from time to time as to avoid impingement on the intestines, especially if this extremity be pointed. Air should not be permitted to enter the abdominal cavity. The fluid should be removed slowly to avoid needless danger of syncope, therefore the caliber of the instrument should not be large.




Fig. 1093.—Potain's aspirator.

*The Remarks.* — Usually a slight incision of the skin is made at the seat of puncture, but if the puncturing agent be sharp this step is not requisite. It is not unwise to introduce a small needle at the outset, and perhaps with a hypodermic syringe attachment, to more safely locate the fluid before the larger instrument is plunged into the abdomen. Usually the puncture is made in the median line midway between the navel and the pubes. If the uterus be distended, the

puncture can be made at either side through the semilunar line or in the median aspect above the limit of distention, as circumstances suggest. The many-tailed bandage is tightened as the fluid escapes, and is confined in place, after the withdrawal, for three or four days.

## HERNIA OF THE ABDOMINAL WALL.

Abdominal hernia is a protrusion of a portion of the contents of the abdomen through an opening in its wall, surrounded by more or less of the tissues forming the wall. With but few exceptions herniæ possess a sac, and this, in every case, is of the parietal peritonæum (Fig. 1094). Only those viscera, such as the caput coli, colon, bladder, pancreas, etc., that are not normally surrounded by peritonæum, can form hernia without a sac. The contents (Fig. 1095) of a hernial sac usually consist, either singly or conjointly,

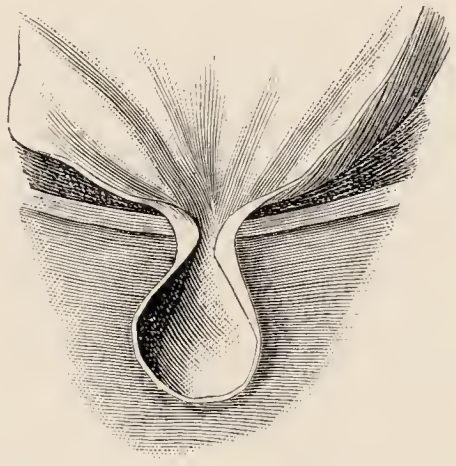


FIG. 1094.—The sac of abdominal hernia.

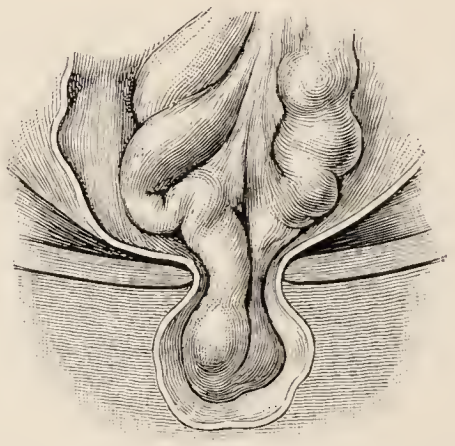


FIG. 1095.—A sac, with intestinal contents.

of small intestine and omentum (Fig. 1113). The normal appearance of the omentum and small intestine should be given a careful study, that the surgeon may be able to determine the various degrees of change in their appearance when subjected to the different influences associated with hernial protrusion. The granular appearance of the omental fat, together with its pale color and extra fibrous structure, will distinguish it from the subserous tissue fat. The omentum and gut, while in the sac, usually bear the same comparative relation to each other as in the abdominal cavity, the former being in front. The sac has a neck and a body, the shape and size of the latter depending upon the amount and density of the surrounding tissues and the nature and compactness of the contents. The neck is the constricted portion, and corresponds in size to the opening through which it escapes, its dimensions being governed by the density of the tissues surrounding it, the age of the protrusion, degree of traction, and compressibility of the contents. A knowledge of the normal characteristics of the peritonæum is essential. Its rough outer and smooth inner surface, the peculiar arrangement of its vessels and its transparency, should be understood. It must not be forgotten, however, that the physical appearance of the sac and contents become changed when long subjected to the vicissitudes attending hernial protrusions.

The tissues composing the wall of the protrusion, called the "coverings of hernia," vary according to the situation, the direction, rapidity of development, and size of the hernia. While these tissues may readily be dis-

tinguished as component parts of a normal abdominal wall, yet, when covering the body of a hernia and more or less changed from the effects of pressure and extraneous influences, they often become difficult of recognition.

In a recent hernia the cellular tissues and fat vary but little in appearance from the normal condition; in an old hernia these tissues are much thinner than in the former. In a recent protrusion the muscular fibers of the cremaster are exceedingly sparse and ill developed, while in the older the influence of traction leads to a marked development of them, which is of great diagnostic importance, as bearing on the progressive depth of the operation incisions and the variety of the protrusion. The normally transparent sac often becomes more or less opaque, and scarcely distinguishable from the tissue lying upon it.

It can be properly said that the changes in the appearance and the anatomical relations of the component parts of a hernia may be so manifold that it will often present as varied and perplexing problems for a speedy solution as any other morbid condition of the body.

The operations applicable to the cure of the various abdominal herniæ are: for strangulated hernia, taxis and division of the constriction; for the reducible hernia, the operation for radical cure; for simple irreducible and obstructed forms of hernia, the liberation of the contents and their return to the proper situation and retention by radical methods.

**Strangulated Hernia.**—In strangulated hernia a constriction located at the neck or within the sac itself causes obstruction of the circulation entirely or in part, thereby exposing the affected portions to the danger of gangrene. The operations for relief of strangulation are *taxis* and *herniotomy*, the latter sometimes being called kelotomy, and in common parlance "an operation for strangulated hernia."

**Taxis.**—Taxis consists in returning the strangulated viscus by manipulation through the channel of escape, aided by force of gravity and relaxation of the constricting agencies, to the abdominal cavity. As a rule, strangulation occurs in protrusions of long standing, where the patient is self-educated in the practice of reduction. It therefore follows, when the case is brought to the attention of the surgeon, that the patient has made persistent but ineffectual efforts to reduce it. Under these circumstances the outlook for the surgeon's success at reduction is not brilliant. He should determine, first, the variety of the hernia, so that his efforts may be intelligently directed; also its condition, that the efforts may not injure the parts or lead to harmful procrastination. If moderate attempt is not sufficient to reduce a strangulated hernia, a hypodermic injection of morphin may be given at once near the seat of the constriction, and the patient put in a warm bath, with the pelvis elevated, and kept there until the combined influences of these measures are felt on the general system. Thus the protrusion can often be returned without serious difficulty by either the patient or surgeon, the former being less liable to employ harmful force because of the pain produced. If these measures fail, an anæsthetic should be given, with the understanding that a failure at reduction then will be followed by an immediate operation.

*Taxis is practiced* by relaxing the tissues contributing to the constriction, and endeavoring to return the part of the hernia first which escaped last, in the direction of the channel through which it appeared. For this purpose empty the bowels and bladder; raise the pelvis, flex the thighs upon the body and so abduct and rotate them as to properly relax the tissues about the groin and abdomen, grasp the tumor with the right hand, and draw it downward carefully to disengage its neck and at the same time to give to it the proper direction for reduction. Gentle, uniform, and continuous pressure is then made upon it with the right hand, while the thumb and fingers of the left steady its upper extremity.

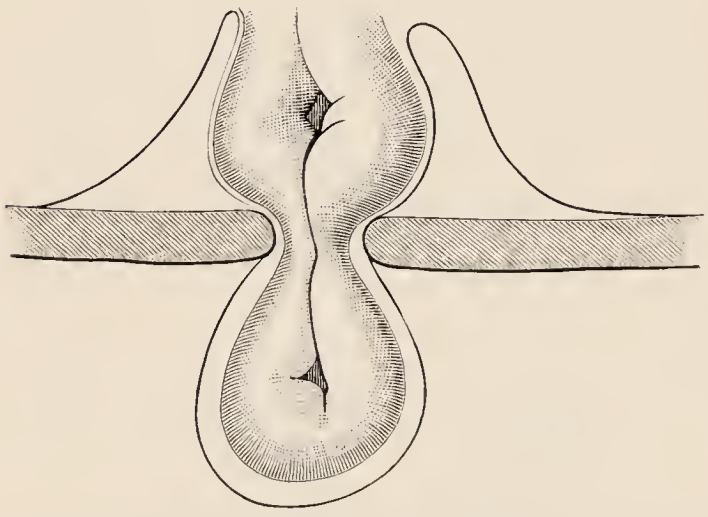


FIG. 1096.—Strangulated hernia and sac, awaiting reduction by taxis.

*The Precautions.*—The sac and contents (Fig. 1096) may be bruised or ruptured from too frequent or forcible manipulation. The protrusion may be reduced *en masse* (Figs. 1097 and 1098), followed by the continuation or recurrence of the symptoms of strangulation. Incision at the seat of strangulation or in the median line of the abdomen offers the only chance of relief in this condition. Taxis should not be practiced if the hernia has been irreducible; if symptoms of inflammation, gangrene, or general peritonitis be present; and if the strangulation be of long standing—twenty-four hours—and have been frequently subjected to manipulative attempts.

If taxis is to be successful, after a brief trial the surgeon will be conscious of a slight gurgling noise, followed by a diminution in the size and tension of the tumor caused by the escape into the bowel above of gas or fæcal matter, which will soon be followed by the return of the entire protrusion. In omental hernia the gurgle will be absent for obvious reasons. Properly directed taxis should not be continued longer than five or ten minutes, and if improperly directed, the sooner stopped the better.

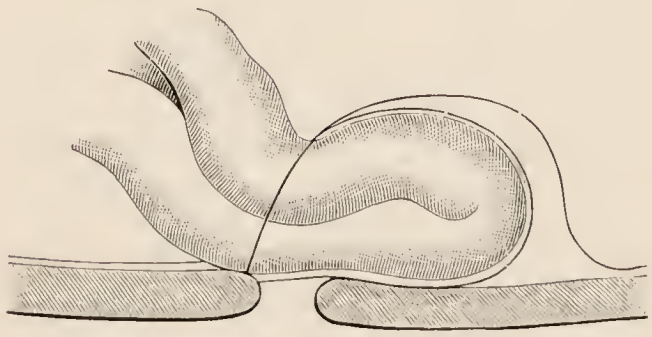


FIG. 1097.—Strangulated hernia, indirect reduction *en masse.*

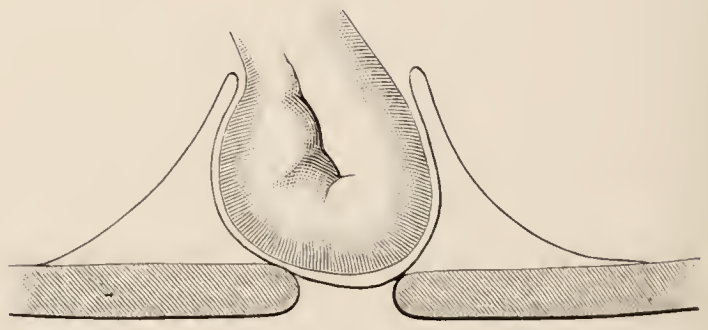


FIG. 1098.—Strangulated hernia, direct reduction *en masse.*

In taxis for the relief of a complete femoral protrusion, it must not be forgotten that it is first necessary to *press downward, and then backward and upward.* It not infrequently happens that a large high femoral hernia is mistaken for an inguinal, and therefore the efforts at reduction are directed

to returning it through the inguinal canal, a manifestly impossible and unfortunate proposition.

*The Results.*—All cases of strangulation die if unrelieved. Taxis gives a death rate of 5.8 per cent in inguinal and about 15 per cent in femoral herniæ.

**Herniotomy.**—The steps of the operation of herniotomy may be logically divided into six: 1, preparation of the patient and division of the tissues; 2, recognition of the sac; 3, opening of the sac; 4, examination of the contents; 5, division of the stricture and return of the protrusion; 6, closure of the wound.

*The Preparation of the Patient and Division of the Tissues.*—After the parts are shaved and cleansed by scrubbing, and suitably placed in a good light, and the patient etherized, an incision two or three inches in length is made through the integument, by transfixion, or direct division in the long axis of the tumor. The remaining structures, forming the wall of the sac, are often picked up one after another with the thumb forceps at the lower angle of the wound and nicked, the grooved director is pushed beneath each one successively, and it is then divided with the scalpel or scissors. Free-hand division of the tissues without the use of the grooved director is proper practice for those whose knowledge of anatomy and whose educated sense of touch will warrant it; but the less experienced will find that more personal comfort and better results will follow the wise employment of the director than with the adoption of the ways of the more experienced. The possibility of recognizing the different layers of hernia will depend very largely on the length of time the hernia has existed, as well as upon the amount of external irritation to which it has been subjected. It is exceptional, however, when the muscular layers and the deep fascia can not be easily recognized. The sac is recognized by its relation to the various overlying tissue planes of special significance; the fascia transversalis, which covers and is separated from it by the fatty subserous tissue, is quite liable at first to be mistaken for the peritonæum. This fascia is dense, opaque, non-translucent, and always present. If in the course of operation a similar tissue has not yet been divided, this one can not be the sac. A minute opening should be made through it at the lower portion of the wound, a grooved director passed beneath it, and its division carefully made. The next layer is the subserous fat, which is often quite well marked. If the surgeon divides the fascia transversalis under the impression that it is the sac, he will then mistake the subserous fat for omentum in the protrusion. This fallacy will be quickly dispelled, however, when he attempts to find the intestine, or to return the supposititious omentum to the abdominal cavity.

*The Recognition of the Sac.*—The sac is globular in form, of a bluish color, tense, and often transparent. A sense of fluctuation is frequently discernible at its lower portion. It can be pinched up between the thumb and finger, and its smooth serous surfaces can be rubbed together, if they be not adherent to the contents. This manifestation is diagnostic. Before the sac is opened, the intestine may be pinched up in the same manner, but it will quickly and easily escape the grasp because of the smooth opposed serous

surfaces. If a small hollow needle be introduced, a drop of fluid will escape; this is characteristic of a hernial sac.

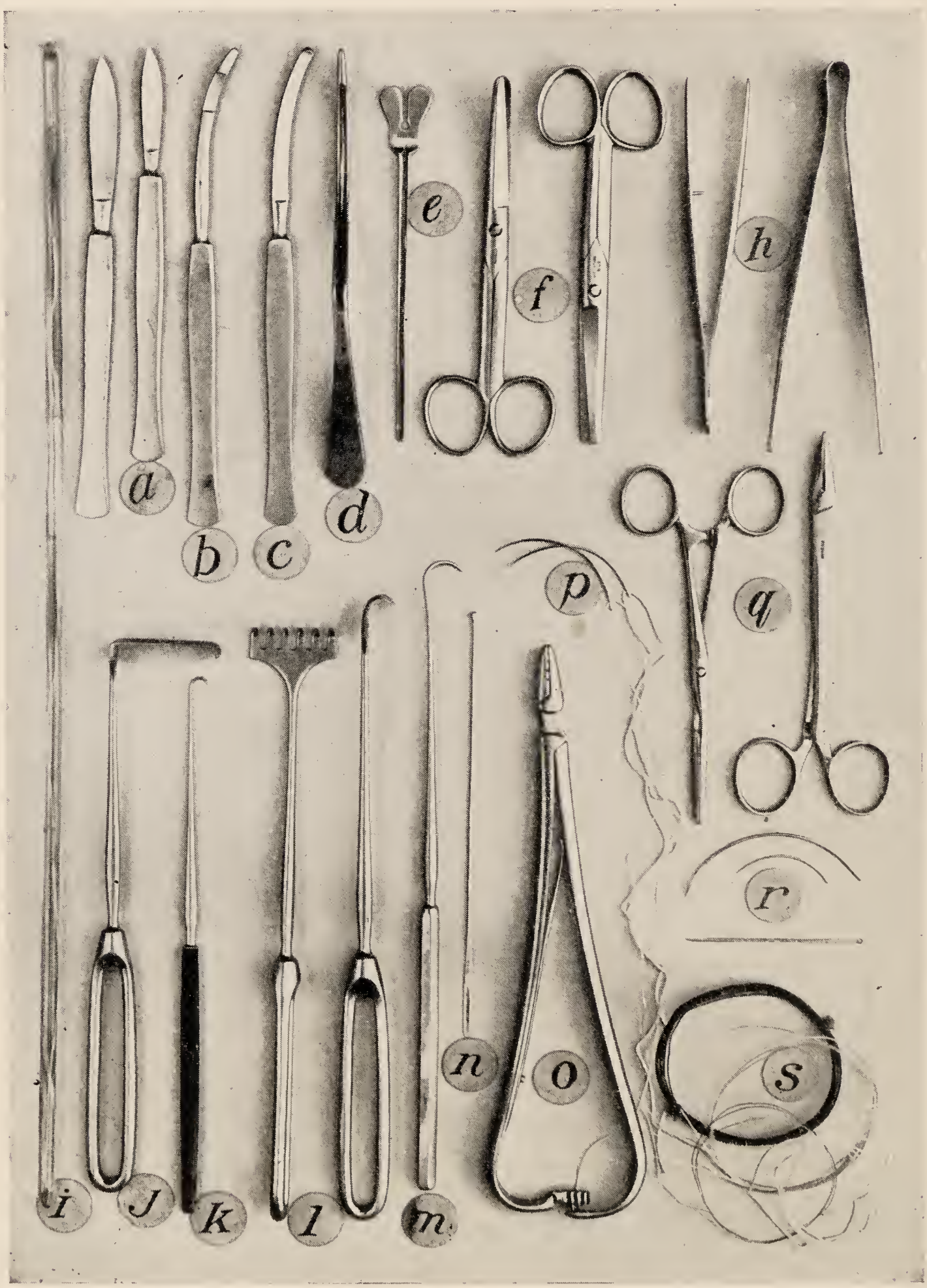



Fig. 1099.—Instruments employed in herniotomy.

*a*. Large and small scalpel. *b*. Hernia bistoury. *c*. Curved, probe-pointed bistoury. *d*. Hernia director. *e*. Common director. *f*. Curved and straight scissors. *h*. Dissecting and mouse-tooth forceps. *i*. Kangaroo tendon in glass tube. *j, l*. Blunt and hooked retractors. *k, m*. Tenaculum and blunt hook. *n*. Silver probe. *o*. Needle holder. *p*. Traction loops. *q*. Small clamp and small needle carrier. *r*. Curved and straight needles. *s*. Chromicized catgut and silkworm gut. Good light is very important.

*Finally*, if the membrane be examined it will be found to surround and limit the protrusion, being movable only as a whole, is denser than the intestine, and devoid of an external serous surface. The sac is picked up with the thumb forceps at the fluctuating point or the point where the drop of fluid escaped, and a small slit is made in it with the knife point held at right angles to the forceps (Fig. 1100). If fluid be present it will then escape. A grooved director is inserted, and an opening made of sufficient size to admit the index finger, which is introduced to determine with certainty the tissue just cut, and also the location of the constriction. If the finger be in the sac, it will come in contact with smooth surfaces on all sides, and, after division of the constriction, it can be passed through the neck of the sac into the abdomen. If the finger be outside the sac serous surfaces will be absent, and the finger can not be passed upward. The existence of cyst constrictions of the sac (Fig. 1101), or a double sac (Fig. 1102), in the line of incision may confuse the surgeon; however, if the finger be introduced into them in turn, their non-serous lining and the limited extent of each variety will expose the fallacy. The sac is opened sufficiently to expose its contents to a careful scrutiny in order that their condition may be carefully considered.

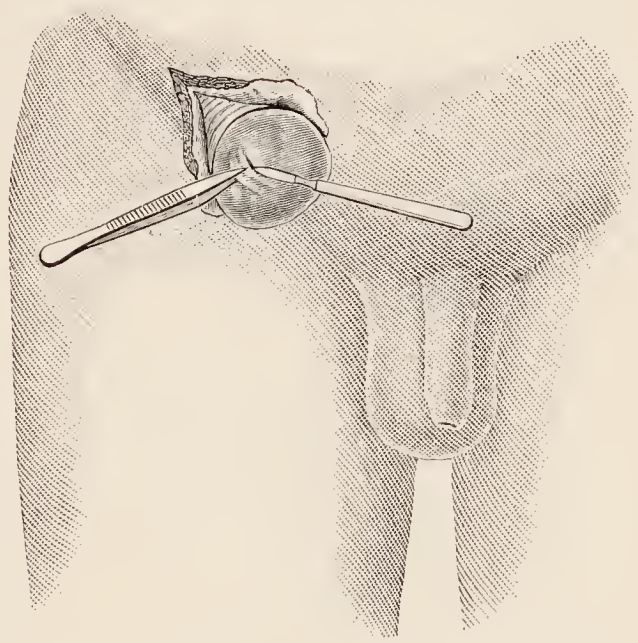


FIG. 1100.—The operation of herniotomy. Nicking hernial sac.

*The Examination of the Contents.*—Unless contraindicated, the constricted point should be divided at once after exposure of the contents of the sac, in order to relieve the strangulation and thus enable the surgeon to estimate its influence on the integrity of the gut. Under all circumstances

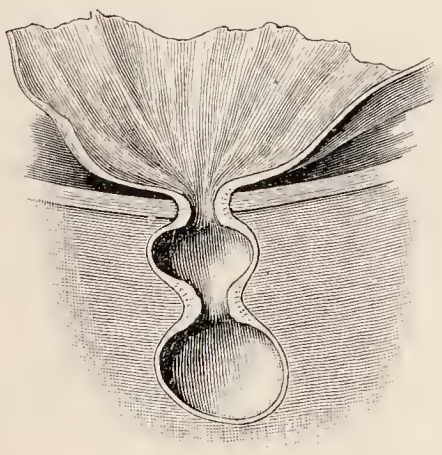


FIG. 1101.—Cystic constriction of hernial sac.

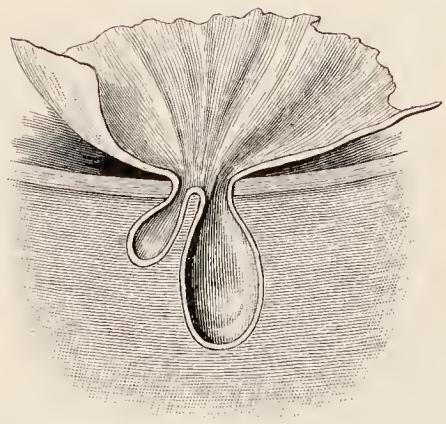


FIG. 1102.—A double hernial sac.

there will be more or less injection of the vessels in strangulation. If the constriction be recent or slight, the changes in the imprisoned tissues will not be great; but when severe, or long continued, or where there has been much handling, the intestine will be more or less purple or blackish, perhaps with isolated ecchymoses and bathed in bloody fluid. The color of the bowel

is not of as much importance in determining the presence of gangrene as the inability to restore the circulation after division of the stricture by the aid of warm fomentations. If the bowel be pricked or slightly scarified and no blood flows; if the circulation be absent and the part becomes cool; if its luster be destroyed and its structure be softened and crackling, it should not be returned. If to all these be added the odor of gangrene, with the presence of a slough, the intestine should be opened to afford exit to its contents and treated with warm fluid aseptic applications. It is good practice to excise at once a circular portion of the intestine corresponding to the gangrenous part and unite the extremities, as described under the head of enterectomy (page 658), if the state of the patient will permit. If the omentum be gangrenous or bulky, ligature it near the mouth of the sac and cut it off; if not, it can be returned. If the contents of the sac be adherent to each other or to the sac, the adhesions may be ruptured if of recent date. It is often necessary, however, to sever them with the knife or scissors, and in doing so the vessels should be ligatured with fine catgut as soon as seen. When the adhesions are very firm and limited, as much of the adherent parts is dissected off as practicable and the remainder returned with the bowel.

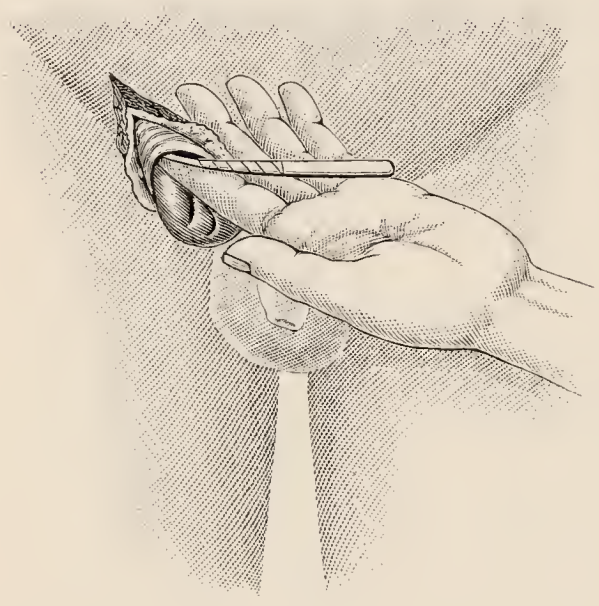


Fig. 1103.—The operation of herniotomy, passing knife along finger.



Fig. 1104.—Levis's hernia director.

*The Division of the Stricture.*—The constriction may be divided from without or from within the sac, the latter being the more frequent site selected. If from without, it may be divided before or after the sac is opened. The former plan is the common practice. If the hernia be small, and strangulation have lasted but a few hours without severe symptoms, and be composed of intestine alone, the constriction may be divided and contents reduced without opening the sac. However, it is much wiser under all circumstances to open the sac and thus be assured of the integrity of the bowel. In division of the constriction within the sac, the finger is carried up to the point of the obstruction, followed quickly by a director (Fig. 1099, *d*, *e*), or a hernia bis-

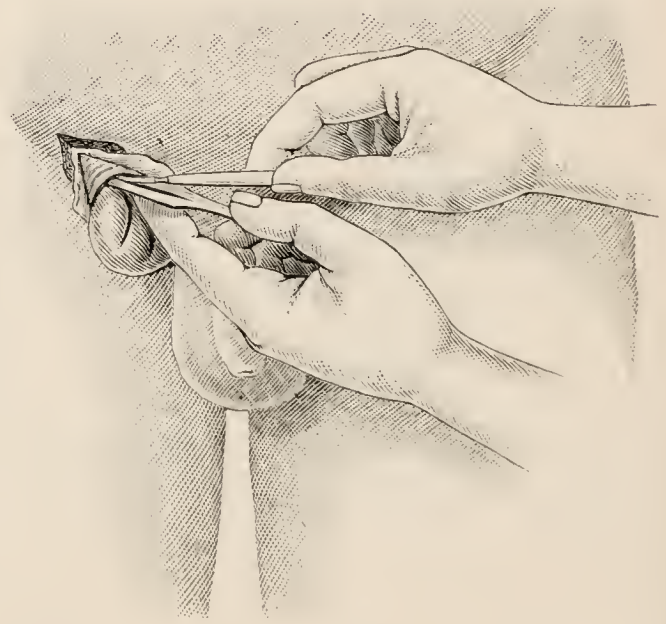


Fig. 1105.—The operation of herniotomy, passing knife along director.

toury or probe-pointed bistoury (*b*, *c*) carried along the finger (Fig. 1103). Division of the constriction can be readily done by passing beneath the constricting tissues the hernia director of Levis (Fig. 1104), which is cautiously carried upward until the constricting band falls into the notches at either side of the groove; a probe-pointed bistoury or the ordinary hernia knife is then carried along the groove, and the stricture divided (Fig. 1105), *not freely*, but only sufficiently *nicked* to permit the return of the intestine. In dividing the constriction the edge of the knife should be directed away from important vessels. If the gut be gangrenous, great caution must be observed in cutting the band, or the adhesions of the bowel to the border of the opening may give way and allow the gut to escape into the abdominal cavity. If extended gangrene be assured and immediate repair be impracticable, it is better not to divide the constriction, thus exposing the patient to the danger of the return of the gangrenous bowel into the abdominal cavity, and also to the entrance of discharges from the wound. Instead open the bowel so as to relieve the obstruction, otherwise allow it to remain undisturbed.

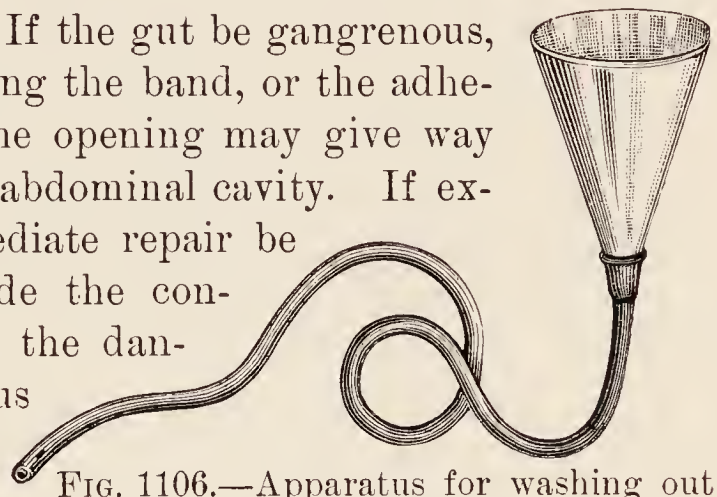


Fig. 1106.—Apparatus for washing out the stomach.

*The General Remarks.*—The field of operation should be scrubbed and shaved widely, the bladder emptied, the stomach washed out thoroughly, especially *if fæcal vomiting* has occurred (Fig. 1106). In fact, lavage is often very serviceable in the event of vomiting from any obstructive cause, as it soothes the stomach, lessens the nausea and vomiting, and thus obviates



Fig. 1107.—Washing out the stomach; introduction of the fluid.



Fig. 1108.—Washing out the stomach; siphoning out the fluid.

the abdominal strain. The patient can quite easily be taught to swallow the tube (page 593)—often without the aid of the finger—and to practice self-lavage by repeatedly changing the altitude of the funnel (Figs. 1107 and 1108).

A blue hernial sac may be mistaken for the gut, and attempts at reduction be persistently made. The sacs of old herniæ in thin people, umbilical and congenital herniæ in all, and the herniæ subjected to long pressure, are thin and often so near to the surface that caution is essential to avoid injury of the gut, especially if adhesion of it to the wall of the sac be present. The fluid in the sac varies in character according to the condition of the contents. Bloody fluid indicates either great degree of constriction or violent or excessive manipulation (taxis); dark and offensive fluid indicates tissue degeneration, gangrene, and perhaps rupture of the gut. The dilatation of the constriction by forcing the finger through it in the presence of the gut should never be attempted, since the gut is bruised by the act. The return of the gut to the abdominal cavity requires care and patience. The mesentery should precede the gut, as a rule. The reduction first of the part that came down last applies to reduction after as well as before operation. Raising the pelvis or foot of the bed facilitates the return. The drawing apart of the opening with hooks, catching the borders of the sac with forcipressure and raising them up in a funnel shape aid the return. Other serviceable manœuvres will occur to the surgeon at the time. The omentum is usually removed after ligaturing it in small masses, and the stump returned entirely into the abdominal cavity (Figs. 1109 and 1110). The leaving of omentum in the canal is objectionable, as it predisposes to volvulus and contributes to the return of hernia. If the gut be much discolored and of doubtful vitality, divide the constriction, withdraw the gut from its grasp and allow it to remain outside surrounded with warm, moist, aseptic dressings. The amount of strangulated intestine depends largely on the extent of the protrusion. A short loop (Fig. 1111) or only a portion of the wall (Fig. 1112) of the gut may be thus involved. If only a small cir-

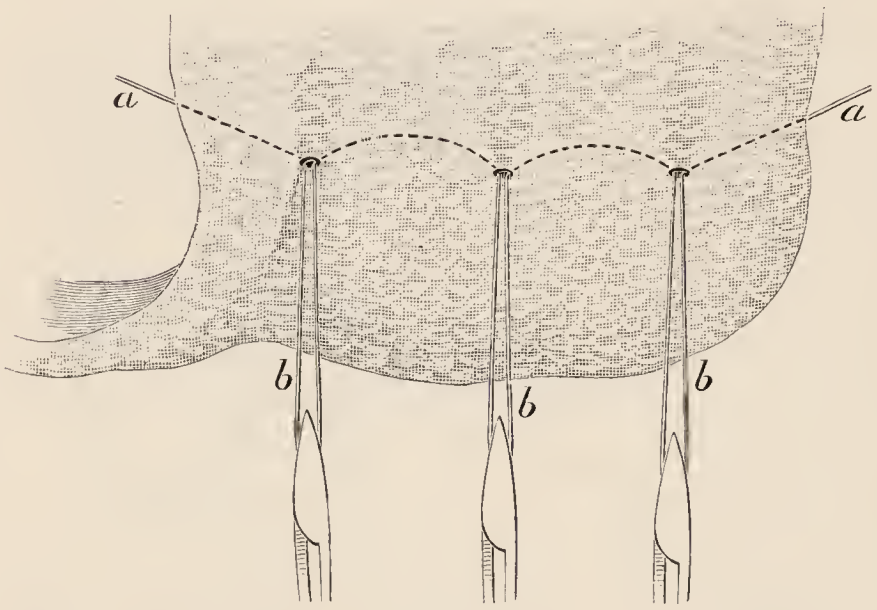



Fig. 1109.—Tying off omentum. *a*, *a*. Ligature drawn through omentum in loops, *b*, *b*, *b*.

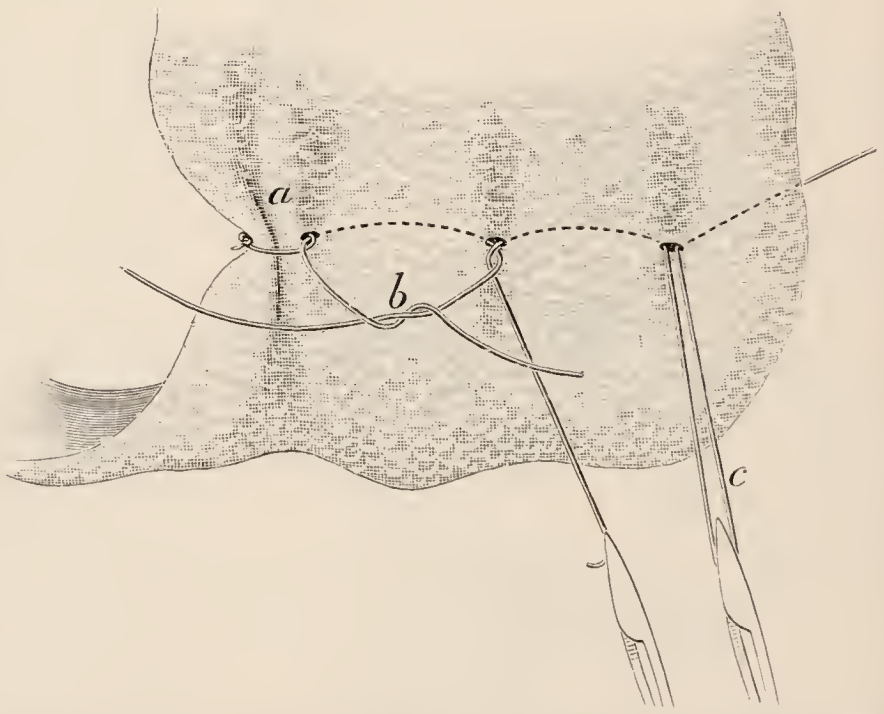



Fig. 1110.—Tying off omentum. *a*. Section ligatured. *b*. Ligature being tied. *c*. Loop for ligaturing.

cumscribed spot be suspected, it may be returned just inside of the abdomen and a large drainage tube introduced into the inner end of the canal, with the idea that the chances of final recovery of both gut and patient are improved by the latter plan. At all events, such seems to be the case. If the patient be kept quiet the relation of the part to the internal ring will change but little, if at all. But, in the face of vomiting and other physical manifestations that disturb the relations of the intestines, the suspected part might readily become removed so far from the opening and the tube as to cause a general peritonitis in case of sloughing, instead of circumscribed adhesion and discharge through the tube as provided for. If gangrene be present, and the patient's condition and the surgeon's preparation will warrant, enterectomy should be practiced as already described (page 658), and by the method best suited to meet all the demands of the occasion. If enterectomy be not advisable, the constriction may be divided or not, as best suits the views of the surgeon. If it be divided and the gut be drawn down and stitched in place, the peritoneal cavity may become infected at once or later. If the constriction and gut be not disturbed, and the bowel be so incised as to allow the escape of its contents, little danger of infection

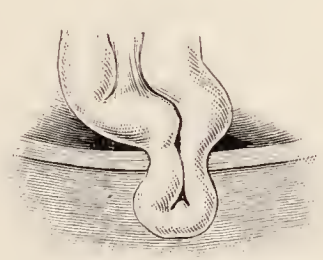


FIG. 1111.—A strangulated short loop of intestine.

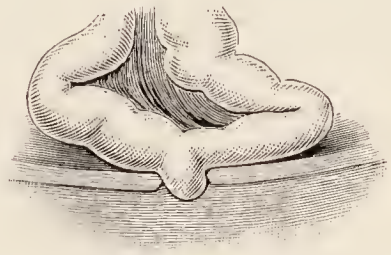


FIG. 1112.—A strangulated portion of wall of intestine.

can arise at any time. The latter is surely the safer procedure and offers no subsequent disadvantage. In gangrenous intestine primary resection gives a death rate of from 47 (Mikulicz) to 50 per cent (McCosh), which is about 25 per cent less than when treated by artificial anus.

*The After-treatment.*—As soon as the bowel is returned, stop all hæmorrhage, unite the wound with catgut carried through the sac, introduce a drainage tube, apply a compress, dress antiseptically, raise the foot of the bed, and quiet the patient with an opiate. If the condition of the patient will approve, a radical cure should follow at once after reduction of the contents of the sac.

**Strangulated Inguinal Hernia.**—A hernia in this situation may be direct or indirect, either of which may be complete or incomplete. In the indirect or oblique form (Figs. 1113 and 1114) a complete hernia enters at the internal abdominal ring, and passes downward and forward in the canal through the external ring. The constricting agent external to the sac may be located at either the internal or external abdominal rings, and rarely in the inguinal canal. The cutting down upon the sac, and detecting and dividing the constriction, is described sufficiently under the general considerations. If the seat of the constriction be at the internal ring it should be divided upward and outward to avoid the epigastric artery (Fig. 1114, *c*) which runs along

its inner border (Fig. 1115). In fact, in the oblique variety the incision upward and outward is always to be made irrespective of the situation of the constriction. *The only fallacy* that may arise is that of mistaking the direct for the indirect form of hernia. In recent and in congenital cases this mistake can hardly occur, but in those of longer standing, especially in acquired oblique hernia, the traction upon tissues of the ring at the neck of the sac drags the ring inward in front of the point of exit of the direct variety, and hence it is quite difficult and often impossible to distinguish between them. If the neck of an oblique hernial sac be dragged inward, the epigastric vessels are pressed directly against its inner aspect, and also encroach upon its upper and lower borders. Under these conditions, if

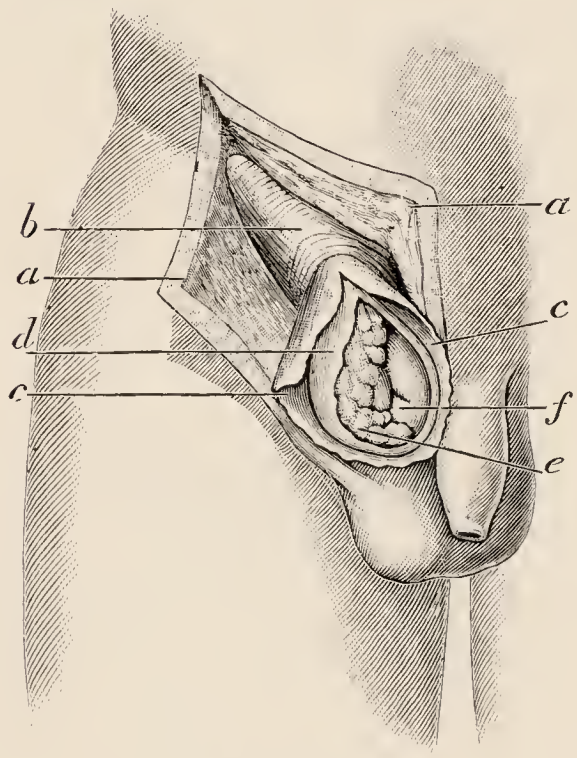



Fig. 1113.

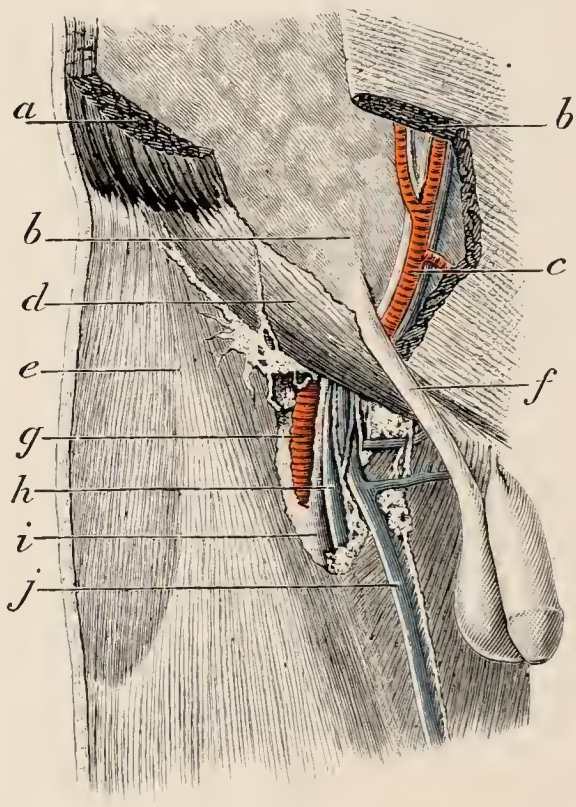



Fig. 1114.

Fig. 1113.—Indirect or oblique inguinal hernia, omental and intestinal contents. *a*, *a*. Integument and superficial fascia. *b*. Aponeurosis of external oblique muscle. *c*. Fascia transversalis. *d*. Sac of hernia. *e*. Omentum. *f*. Intestine.

Fig. 1114.—The anatomy of inguinal and femoral regions, showing course of descent of indirect or oblique inguinal hernia. *a*. Divided borders of abdominal muscles. *b*. Transversalis fascia. *c*. Deep epigastric vessels. *d*. Aponeurosis of external oblique muscle. *e*. Fascia lata. *f*. Spermatic cord. *g*. Femoral artery. *h*. Femoral vein. *i*. Sheath of femoral vessels. *j*. Saphenous vein.

the stricture be divided agreeably to directions often given—parallel with the course of the epigastric vessels—or even upward or slightly outward, these vessels will be in danger of injury.

If, on the other hand, the protrusion be of the direct variety, and the incision be made upward and outward, under the impression that it is a displaced indirect form of hernia, the epigastric vessels will then be exposed to peril (Fig. 1116). It is readily seen, therefore, that great caution should be employed in distinguishing between the two prior to cutting the constriction. It is practically impossible to discriminate between them until the coverings of the sac are examined. The oblique variety has for a covering the cremaster muscle, which can readily be distinguished in an old hernia. This muscle never forms the covering of a direct hernia *except* when it

passes to the outer side of the conjoined tendon, when its coverings are similar to those of the oblique form. It therefore follows, from the anatomical relations, that when the cremaster does not form a covering the constriction should be divided upward and inward—that is, away from the epigastric vessels. If the cremaster forms one of the coverings, then the constriction must be cut upward and outward, provided there be no evidence that it is a direct hernia which has escaped to the outer side of the conjoined tendon. This latter condition is fortunately rare, and this, when taken in connection with the location of the tumor at its incipiency, should settle the question between the two. If, however, it be impracticable to settle the doubt, dull the edge of the knife by drawing it across a piece of metal, and then proceed carefully to nick the neck of the constriction in an upward direction. If the constriction be at the external abdominal ring, it matters little in which direction the cut is made; however, to simplify matters, the direction upward and outward should still be adhered to. The methods of examination of the contents of the sac and their reduction, together with the subsequent treatment, are sufficiently considered in the preceding pages. If the protrusion be incomplete the treatment is similar, and the matter simplified by the inability to confound the direct with the indirect varieties of this form.

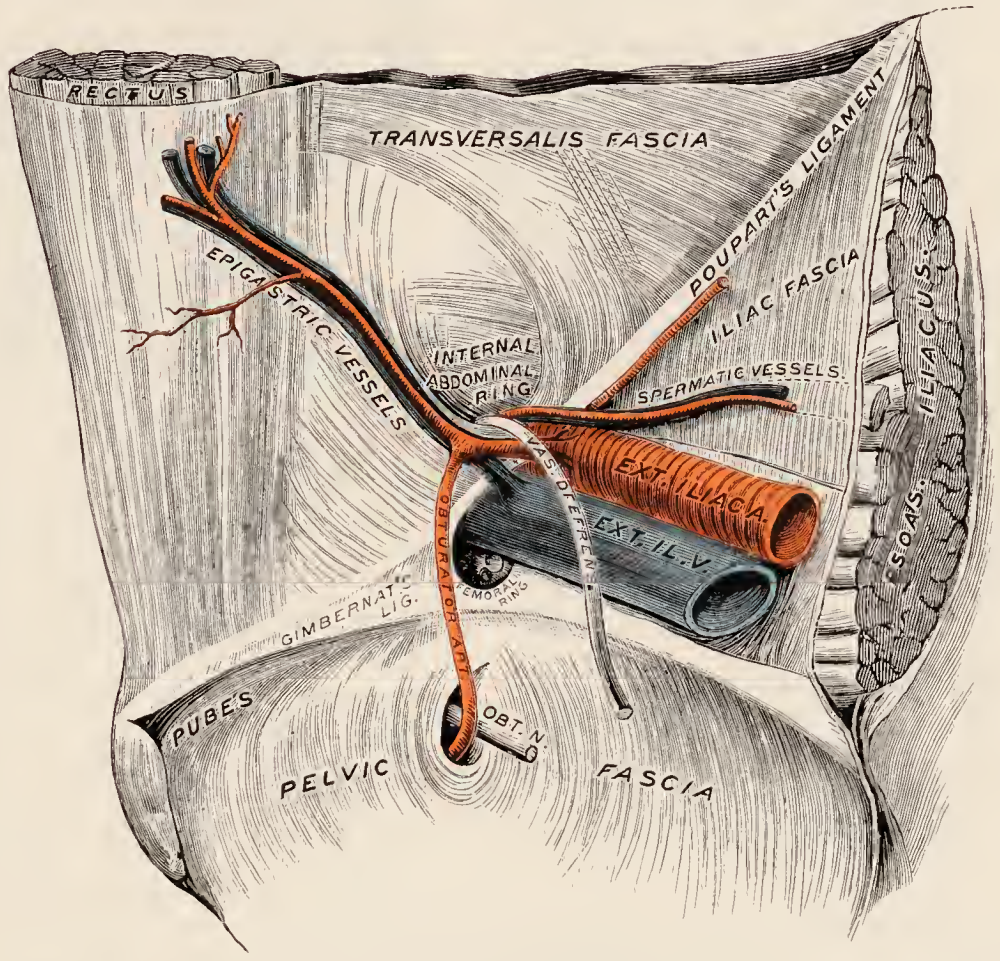



FIG. 1115.—The course of deep epigastric and obturator vessels.

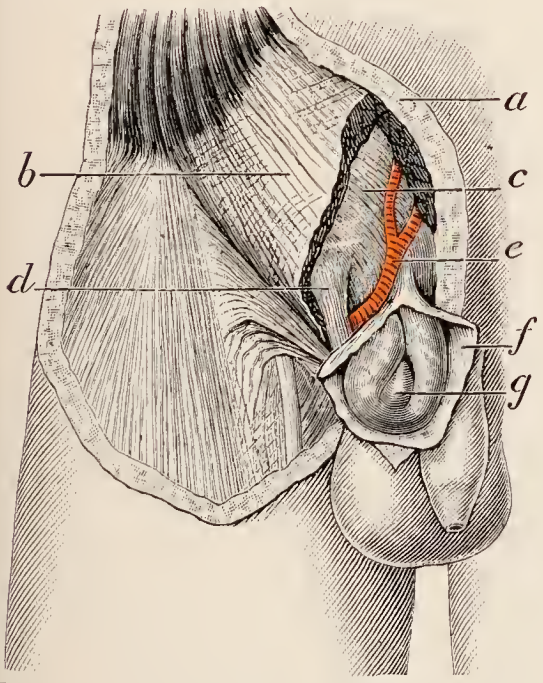



FIG. 1116.—Direct inguinal hernia. *a*. Integument and fascia. *b*. Aponeurosis of external oblique muscle. *d*. Spermatic cord. *e*. Epigastric vessels. *f*. Sac. *g*. Hernial contents.

*The Results.*—The general rate of mortality of operation for strangulated inguinal hernia is about 19 per cent.

**Strangulated Femoral Hernia.**—The protrusion in this instance enters at the femoral or crural ring at the inner side of the femoral vein (Fig. 1117), passing between the vein and Gimbernat's ligament, and the inner boundary

of the femoral canal for about half an inch, to the upper portion of the saphenous opening (Figs. 1118 and 1119), through which it escapes; afterward, in many instances, it passes upward and rests upon the falciform process of that opening (Fig. 1120). The *two common points of constriction* are Gimbernat's ligament (Fig. 1117) and the sharp border of the falciform process of the saphenous opening. The important boundaries of the upper extremity of the crural canal are, within, Gimbernat's ligament, and without, the femoral vein (Fig. 1117), surrounded by its sheath. Throughout the course of this canal the femoral vein lies at the outer side. The distinctive coverings of this protrusion are the cribriform fascia, crural sheath, and septum crurale. The important vascular relations are those of the femoral vein and the obturator artery.

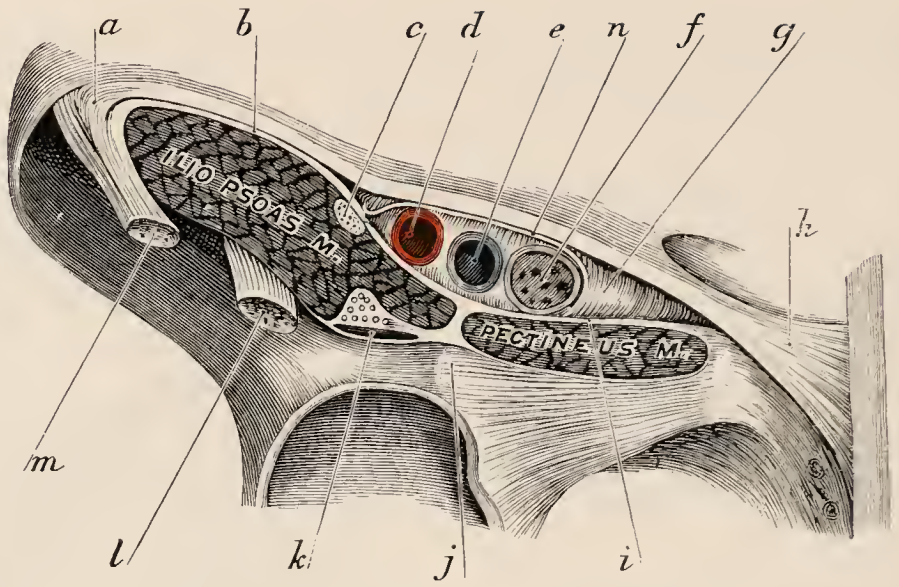



FIG. 1117.—Transverse section below Poupart's ligament. *a*. Anterior superior spine of the ilium. *b*. Iliac fascia. *c*. Anterior crural nerve. *d*. Femoral artery. *e*. Femoral vein. *f*. Septum crurale. *g*. Gimbernat's ligament. *h*. Spine of pubes. *i*. Pectineal fascia. *j*. Ilio-pectineal eminence. *k*. Iliac bursa. *l*. Rectus femoris muscle. *m*. Sartorius muscle. *n*. Transversalis fascia.

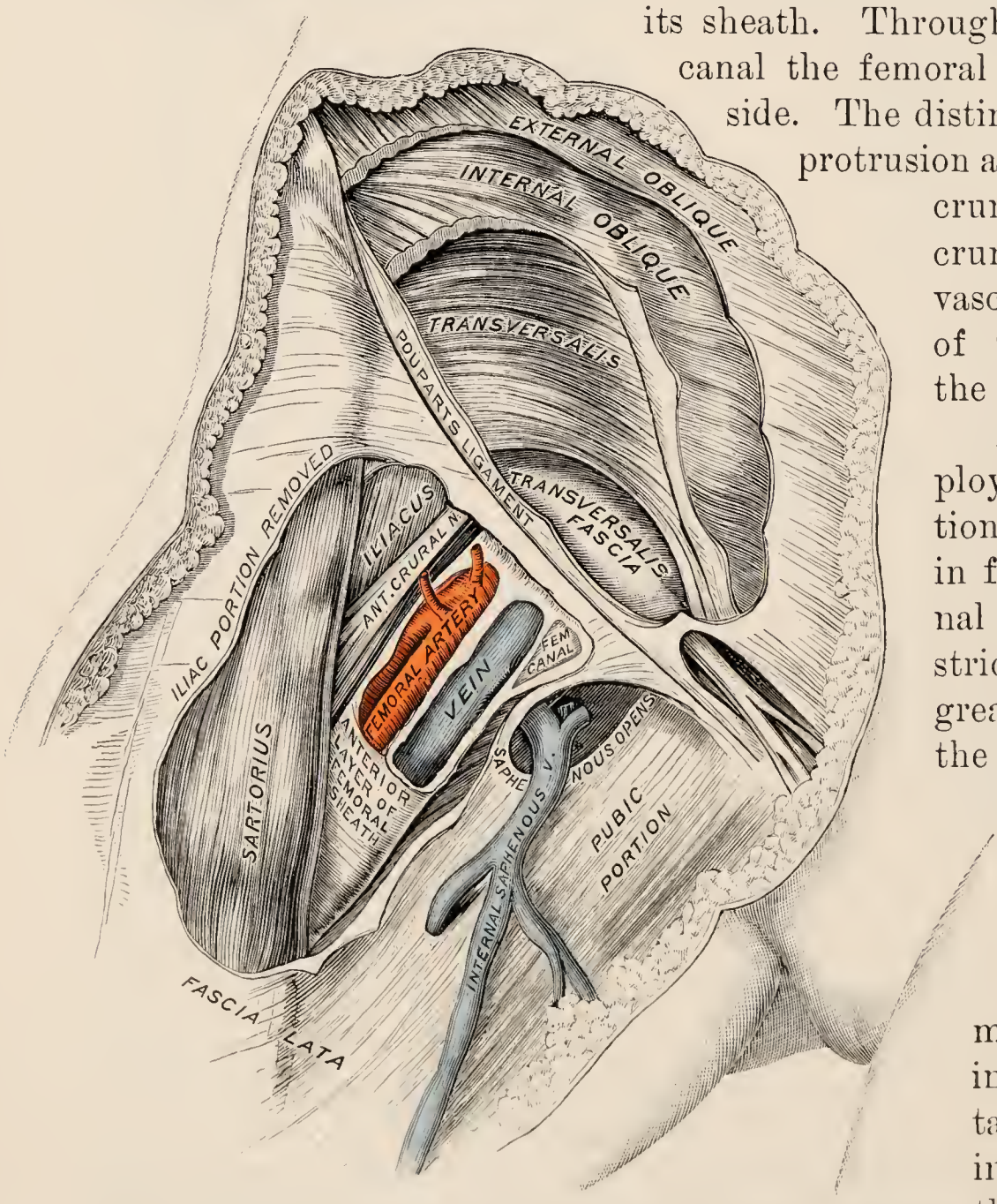



FIG. 1118.—Anatomy of the femoral region, showing through opening in femoral sheath the relations of the femoral canal to the femoral vein and saphenous opening.

*Taxis* should be employed with greater caution and for a shorter time in femoral than in inguinal hernia, since the constricting influences are greater, and the neck of the sac much smaller in the former. The fact is again referred to that a femoral hernia that extends upward toward Poupart's ligament, sometimes reaching above it, may be mistaken for one of the inguinal variety; and, therefore, the efforts at reduction are directed

to returning it through the external abdominal ring instead of pushing it downward, backward, and upward, as is necessary to effect a reduction of the former.

*The Operation.*—The field of operation should be washed, shaved, and disinfected; the patient placed on the back, the thigh flexed and rotated outward, the bladder emptied, the patient anæsthetized, and a vertical incision made upon the tumor in the line of the long axis of the femoral canal, with the center over the border of the falciform process (Fig. 1120). The integument and superficial fascia should be carefully divided, thus exposing the *cribriform fascia*, which in fleshy subjects is loaded with fat. This fascia and the glands connected with it (Fig. 1120), especially if the latter be enlarged, form a mass often difficult to understand. The glands should be pushed aside and the remainder of the structure carefully divided. It can hardly be mistaken for anything but the omentum, or the deeper layer of fatty tissues. The absence of the sac will readily expose the former fallacy, and the presence of the latter will soon be disclosed. The *femoral or crural sheath* comes next in order (Fig. 1118). It is dense, like the fascia transversalis, of which it is a prolongation, and might be mistaken for the sac did it not present appearances of a different character, which have already been described. The *septum crurale* (Fig. 1117) will hardly form one of the entire coverings if the protrusion be large; if it does form a covering it will be

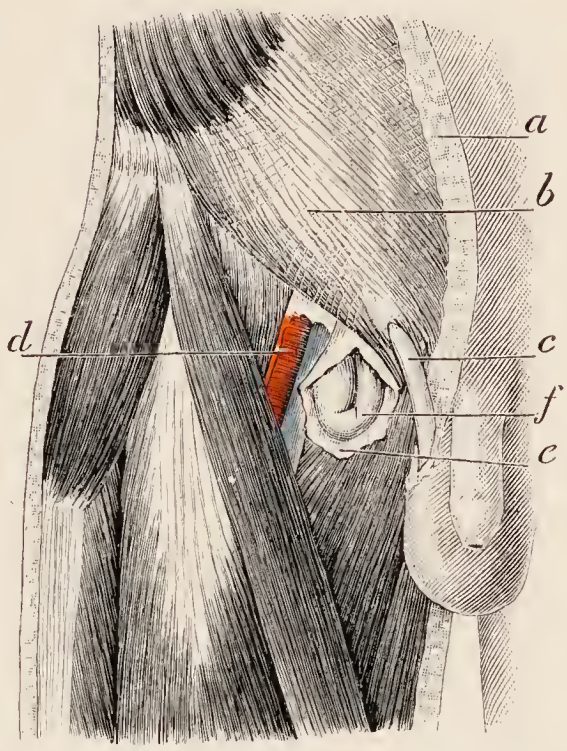



FIG. 1119.—Complete femoral hernia. *a*. Integument and fascia. *b*. Aponeurosis of external oblique muscle. *c*. Spermatic cord. *d*. Femoral vessels. *e*. Sac of hernia. *f*. Intestinal contents of hernia.

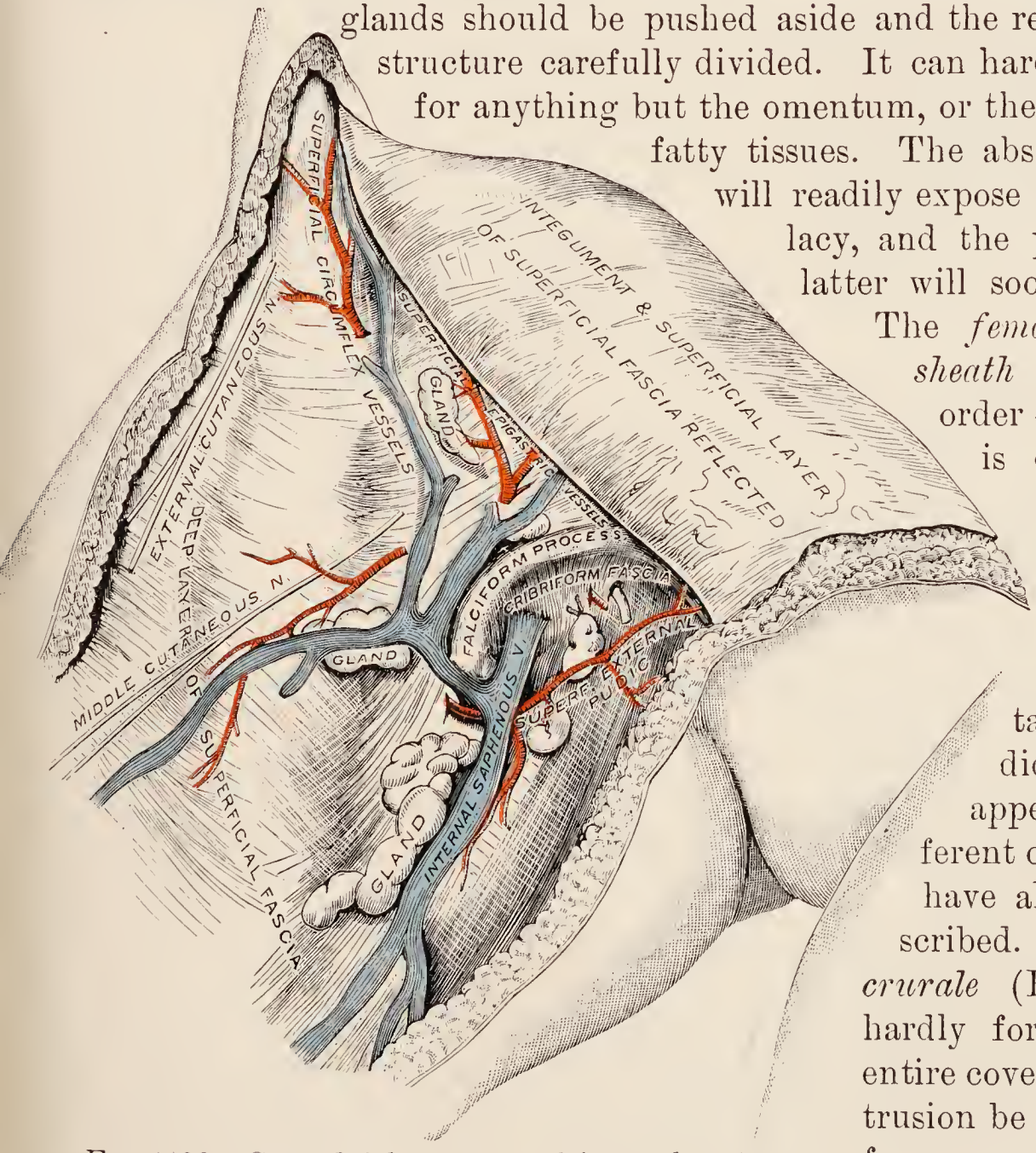



FIG. 1120.—Superficial anatomy of femoral region.

much diminished in thickness, and somewhat blended with the subserous tissue. It sometimes happens that the small lymphatic gland, which normally exists between the subserous tissue and the septum crurale, can be distinguished, which, of course, settles all doubts as to the identity of the tissues under inspection. The careful use of the knife and director soon exposes the sac with its characteristic appearance. It should be opened at the lower extremity with the precautions previously enjoined, and the stricture sought for and divided. If the stricture be, as is usual, at the free border of the falciform process, flex the thigh, rotate it inward, and if no further obstruction exists, the protrusion can be reduced. If the constriction be at the free border of Gimbernat's ligament, this, too, must be nicked. It is necessary to recall, before the nicking, that the obturator artery once in three and a half cases arises from the epigastric, and although it usually lies in contact with the vein in its descent (Fig. 1121), and is therefore out of danger, yet it not infrequently curves inward along the free margin of Gimbernat's ligament (Fig. 1115), thus nearly encircling the neck of the sac, and therefore is in great danger of being cut. The knife should be made quite dull, and the ligament nicked superficially and obliquely upward and inward in this instance. The tip of the little finger may then perhaps safely be inserted and the artery sought for along the posterior surface of the ligament; if not discovered, the nicking may be repeated, or firm traction with the finger against the ligament may be made, aided perhaps by a hook, so as to tear or stretch it. This vessel may have been cut ten or twelve times in this operation, but in each instance the bleeding was controlled by ligature or compression, and the patient recovered. After returning the protrusion the wound is closed and dressed antiseptically.

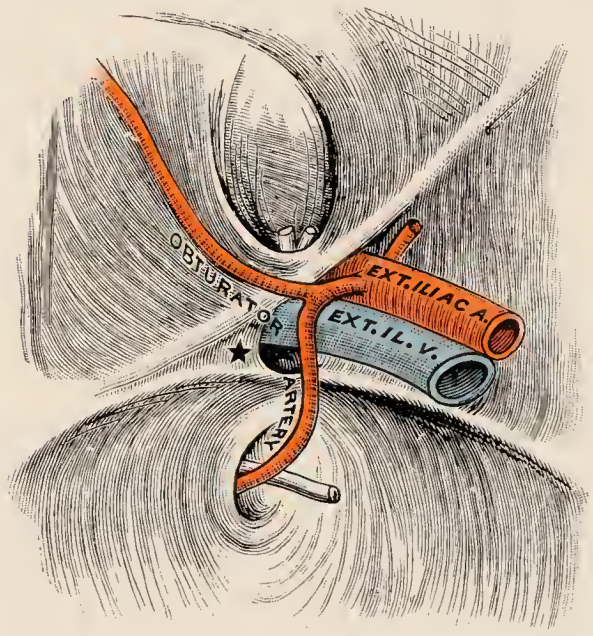



FIG. 1121.—The curve of the obturator artery and consequent relation to Gimbernat's ligament (*).

Femoral herniæ do not always follow the course just described; they take, though infrequently, anomalous courses, sometimes appearing at the outer side, or behind the femoral vessels. They have been known to pass through Gimbernat's ligament. It is important to know that in all the anomalous cases the neck of the sac lies closely associated with the epigastric artery alone, or together with the obturator, and troublesome and even fatal hæmorrhages may be caused unless care is taken in dividing the constriction.

*The Results.*—The general death rate after operation for strangulated femoral hernia is about 24 per cent.

**Strangulated Umbilical Hernia.**—Umbilical herniæ appear at all ages of life and in response to devious causes. The symptoms of strangulation are generally acute, although large, old, and persistent protrusions of this kind sometimes do not cause pronounced manifestations.

*The Operation.*—After thorough cleansing of the surface, make an elliptical incision at the median line broad enough to include the superabundant tissue; deepen the incision at one side down to the aponeurotic structure; reflect this half of the ellipse toward the median line, thus exposing the neck of the sac and the margin of the hernial opening at that side; repeat the step at the opposite side, thereby isolating the hernial opening, the neck and body of the sac, the latter still bearing the integumentary ellipse; open the sac at the point farthest from adhesions and at the lower border, if practicable; expose and examine the contents; remove omentum (Figs. 1109 and 1110), retain and repair gangrenous intestine, enlarge the hernial orifice above and below and return the sound parts to the belly; sever the neck of the sac at the border of the hernial opening and remove the sac with the integumentary ellipse; freshen the border of the hernial opening and close it directly by sewing or after the method of radical cure (page 915); dress the wound, put the patient in bed on the back for three or four weeks. A supporting pad is worn for months after resuming the erect posture. If the condition of the patient will permit, a radical cure should be practiced at once. The constriction should be divided without the sac when feasible, but the contents ought not to be returned until examined through an incision made into the sac.

*The Precautions.*—Taxis in strangulated umbilical hernia should be practiced with especial care, to avoid injury of the contents of the sac. If the intestine be gangrenous, the constriction causing it should not be divided unless repair of the gut is made at once, because infection of the peritoneal cavity is almost sure to follow on account of the relations of the wound to the dorsal position of the patient.

*The Results.*—A general death rate of about 50 per cent follows operations for strangulation. If prompt action be taken a much better outlook than this may be expected.

**Strangulated Obturator Hernia** (Fig. 1122).—The viscus in this instance follows the course of the obturator vessels in its escape from the pelvis, and lies beneath the pectineus and obturator muscles. It is usually small and may not be detected during life.

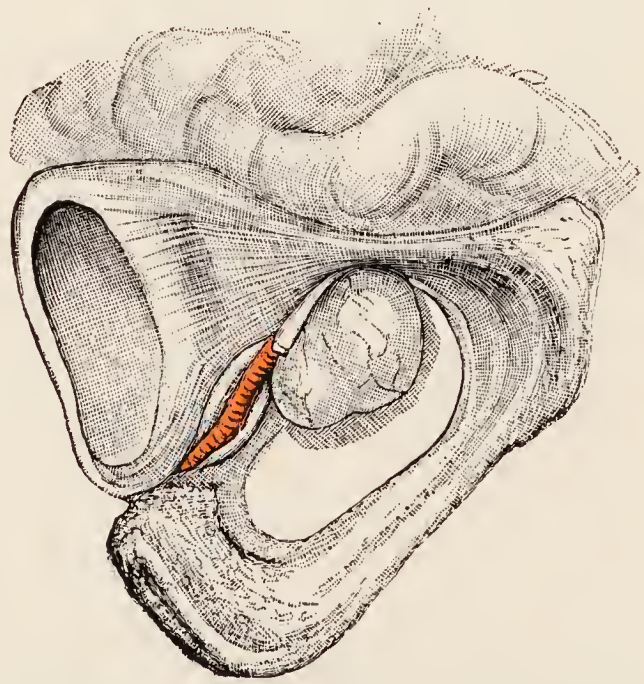


FIG. 1122.—The relation of an obturator hernia to the obturator membrane and vessels, and to the bone.

*The incision* for its relief is made over the tumor at the inner side of and parallel to the femoral vessels. *The constriction* has been found in the fibers of the pectineus muscle; and it is usually necessary to divide some fibers of this muscle in order to expose the opening through which the bowel has escaped. The relation of the obturator vessels to the neck of the sac varies, being equally frequent at the outer and inner sides, never in front, but occasionally behind it. If the constriction be found at the

foramen, it will require much caution to divide it without implicating these vessels. Abdominal section has been practiced in many instances of relief.

*The Results.*—The death rate is about 80 per cent with surgical treatment, owing, no doubt, to delay in detection and diagnosis.

**Strangulated ventral hernia** is treated not unlike that of umbilical. Strangulated lumbar (Fig. 1123), ischiatic (Figs. 1124 and 1125), perineal, and diaphragmatic herniæ (page 1035) are especially dangerous because of failure of recognition, if at all, until too late for operative benefit.

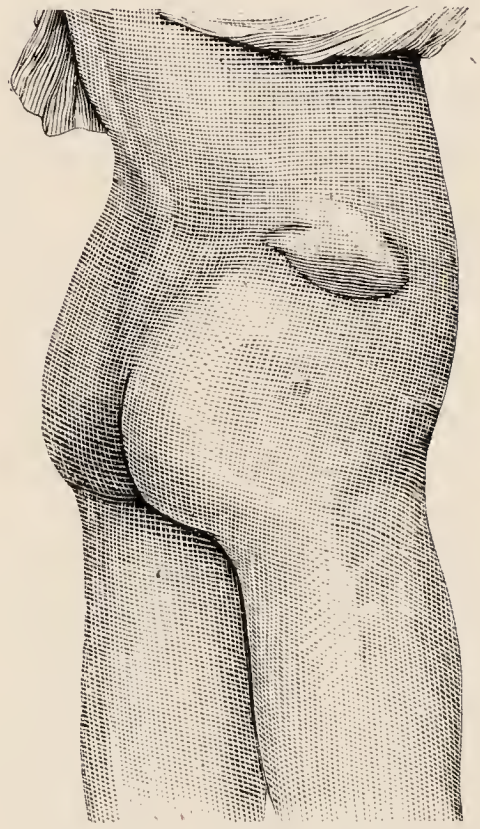


FIG. 1123.—A lumbar hernia escaping through the canal of Petit.

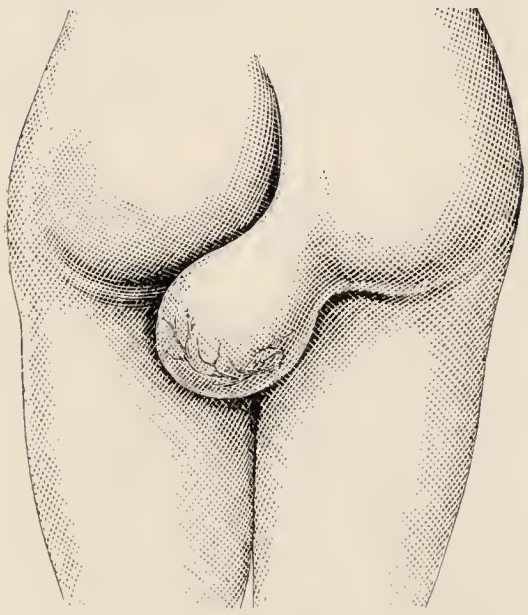


FIG. 1124.—A large ischiatic hernia.

**Retroperitoneal Herniæ.**—This variety of hernia is rarely determined except when revealed by cœliotomy for the relief of intestinal obstruction due to strangulation.

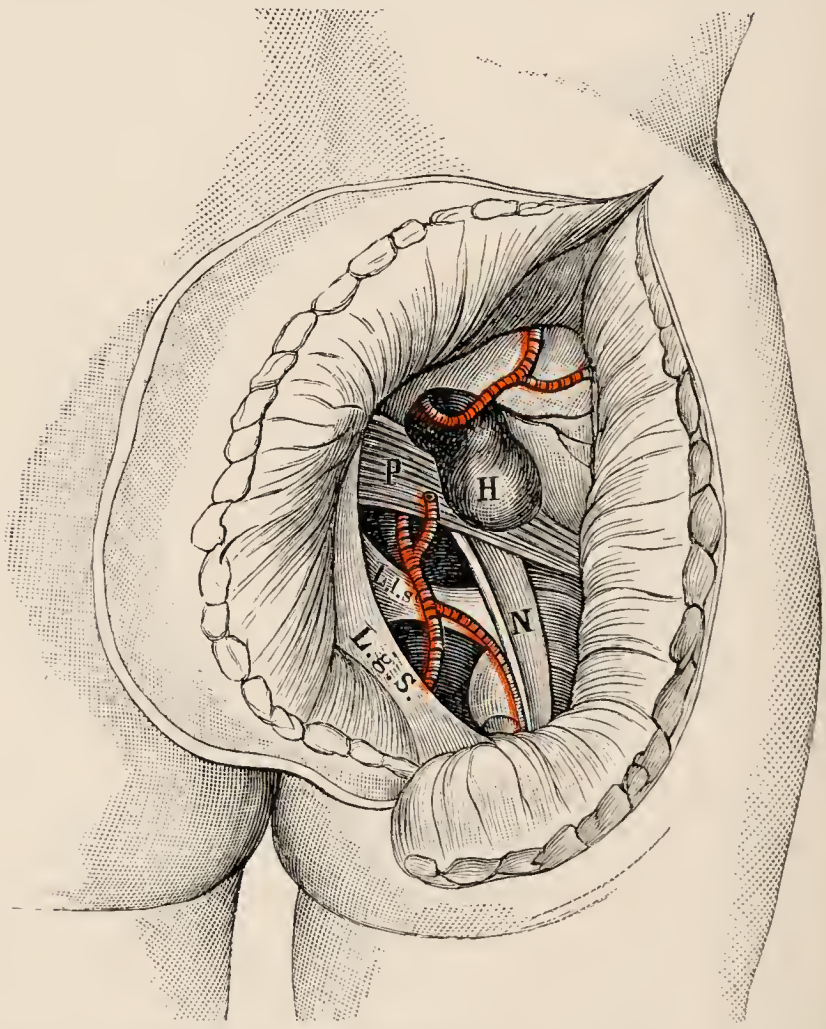



FIG. 1125.—The contiguous anatomy of ischiatic hernia. *H.* The hernia. *P.* Pyriformis muscle. *N.* Great sciatic nerve. *L. g. s.* Great sacro-sciatic ligament. *L. l. s.* Lesser sacro-sciatic ligament. The gluteal nerve and vessels are seen above the hernia, and the sciatic below.

The fossa duodeno-jejunalis of Treitz (Fig. 964), the subcæcal fossa of the inner side of the cæcum, the foramen of Winslow and the fossa intersigmoidalis at the under surface of the meso-colon and sigmoid flexure, are the most frequent sites of this form of hernia, and occur in the order stated. They may be small or large, even extending to nearly the whole of the small intestine (Fig. 1126). The constriction is relieved and the point of escape enlarged sufficiently to permit of the withdrawal and proper replacement of the intestines. The technique referable to operations of the peritoneal

cavity, hernial protrusions, and repair of the peritonæum, will meet the requirements of these cases.

Sixty-four duodenal, 12 pericæcal, 8 of the foramen of Winslow, and 3 intersigmoidal herniæ have been collated by Jonnesco.

**The Operations for the Radical Cure of Hernia.**—Various operative methods have been devised for the cure of hernia, the majority of which have not withstood the test of time and the ever-increasing simplicity of operative technique. The operation for radical cure of hernia should be practiced with much discretion, as all persons thus affected are not proper subjects, nor are all herniæ suitable ones for operation. Elderly persons with large herniæ, and infirm ones with hernial protrusions that can be retained in place, should not be subjected to operation except for strenuous reasons, and then only after they are made aware of the danger which the procedure invites. The young and vigorous are the proper subjects for this treatment. Primary union without annoyance from buried sutures thereafter are the local desiderata of greatest importance. Therefore, rigid asepsis is to be employed when possible. Kangaroo tendon is the most reliable absorbable, and silver wire the best unabsorbable, suture now in use. Silken sutures are very serviceable indeed when thoroughly aseptic. Silkworm gut and catgut should be discarded for this purpose.

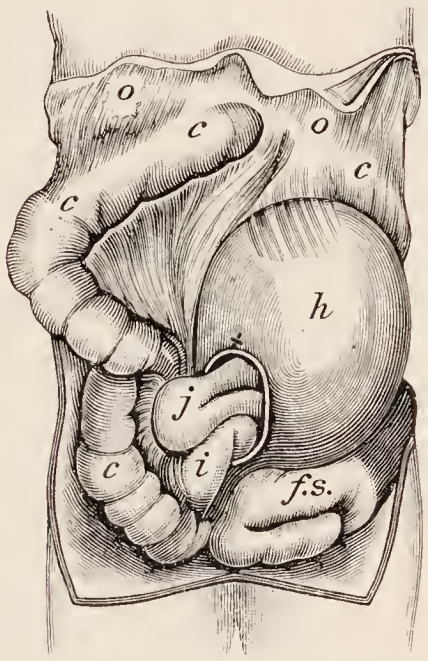



FIG. 1126.—Retroperitoneal hernia of the small intestine. *h*. Sac of hernia. *j*. Protruding loop of jejunum. *i*. Ileum. *c, c. c. c.* Ascending and transverse colon. *f.s.* Sigmoid flexure. *o, o.* Omentum.

**Bassini's Method of Operation** (*Inguinal Hernia*).—Bassini's method is comparatively simple and thoroughly efficient, and is practiced oftener at the present time in this country than any other method.

*The Operation.*—Make an oblique incision half an inch above and parallel with Poupart's ligament from a point opposite the anterior superior spine of the ilium to the crest of the pubes; carry a traction suture between the borders of the respective flaps and draw them aside; expose and divide on a director the aponeurosis of the external oblique from the external abdominal ring along the line of incision for two or three inches (Fig. 1127); seize with forceps in turn the borders of the aponeurotic flaps and separate the upper inward to the outer edge of the rectus abdominis muscle, and the lower down to and along Poupart's ligament, from the underlying tissues with the finger or handle of the scalpel, thus exposing to view the contents of the inguinal canal; pass traction sutures through the respective borders of the opening and draw them aside and raise *en masse* from the inguinal canal with the fingers, aided with blunt curved scissors, the hernial sac and the cord (Fig. 1128); with the thumbs and fingers aided with forceps, separate the cord and its vessels from the sac from a point high within the internal ring downward; open the sac at the dependent part, examine the contents and return them to the peritoneal cavity; transfix the neck of the sac and liga-

ture it in halves with strong catgut, and cut it off (Fig. 1129); draw back the edges of the aponeurotic flaps and raise the cord out of the way; introduce beneath the cord from before backward and within outward, or the reverse, successively four or five buried kangaroo-tendon sutures connecting Poupart's ligament with the conjoined tendon, and the lower fibers of the internal oblique and transversalis (Fig. 1130); tie each snugly, thus joining directly with Poupart's ligament the conjoined tendon and a portion of the lower fibers of the internal oblique and transversalis muscles (Fig. 1131); replace the cord and unite the borders of the aponeurotic flaps over it with a continuous suture of catgut (Fig. 1132); close the integumentary

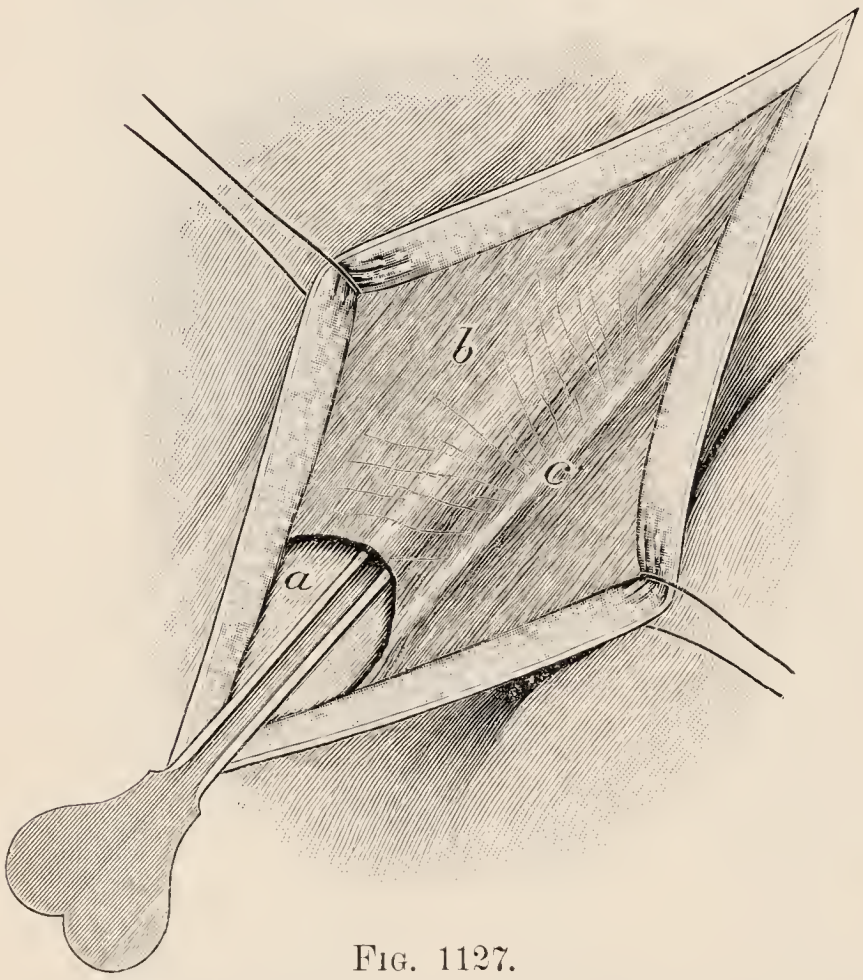



Fig. 1127.

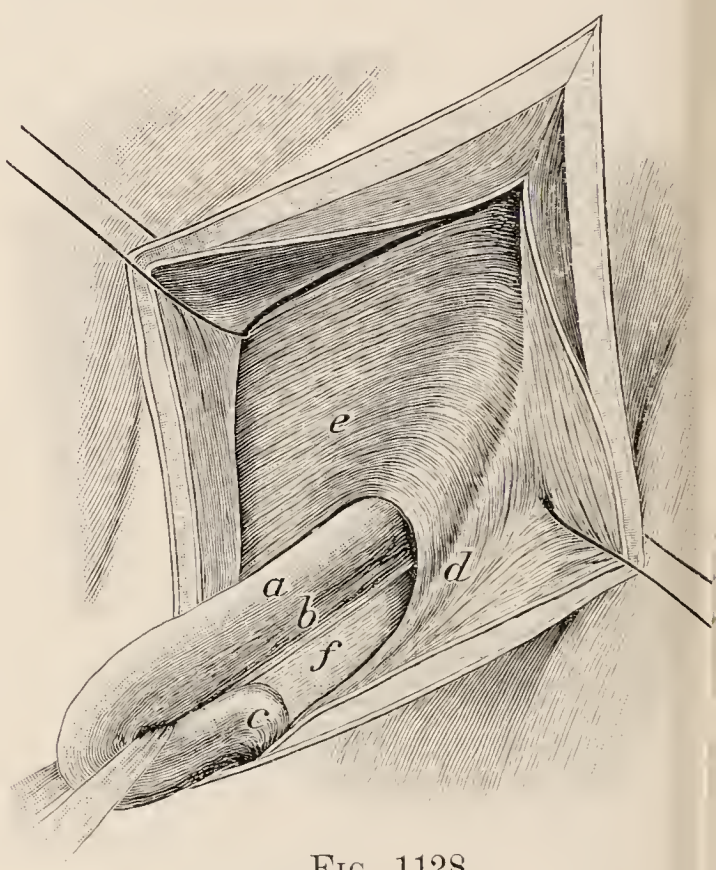



Fig. 1128.

Fig. 1127.—Operation for the radical cure of inguinal hernia, Bassini's method. *a*. Hernia and cord. *b*. Aponeurosis of external oblique muscle. *c*. Poupart's ligament.

Fig. 1128.—Operation for the radical cure of inguinal hernia, Bassini's method. *a* and *b*. Sac and cord raised *en masse* and held with fold of gauze. *c*. Cord entering scrotum. *d*. Poupart's ligament. *e*. Arched fibers of internal oblique muscle. *f*. Transversalis fascia.

incision without drainage and dress in the usual manner, confining the dressings in place with a hip spica.

*The Precautions.*—Poupart's ligament should be carefully outlined by palpation and introduction of the finger into the inguinal canal before making the primary incision, to avoid its misplacement. In transfixing and tying omentum, do not forget that a transfixed vessel will bleed persistently, and, if returned to the abdominal cavity, may cause death from hæmorrhage before the cause is suspected; therefore, examine the omental stump carefully for oozing or insecure ligaturing before its return to the cavity. Pinching of the cord by approximation of the tissues in closing the canal with buried sutures is liable to happen and should be avoided. If the deep epigastric artery be tortuous, or the needle be dipped incautiously in sewing, the vessel may be transfixed by the needle, causing perplexing hæmorrhage. The

writer once had an experience of this kind. Twisting the sac is sometimes practiced, and serves to isolate it somewhat more and define the seat of the neck. However, if it be twisted too vigorously and be then transfixed and tied, and cut off before untwisting, the untwisting may loosen the ligature and render it insecure. Repair is made in this instance by sewing together with a mattress or continuous catgut or silk suture the borders of the opening, the same as in other peritoneal wounds. It is safer practice to make the sac tense by downward traction, followed by upward pressure at its neck between the thumb and fingers to push away the contents, succeeded by interval inspection to note their absence before the neck of the sac is transfixed. Even with this degree of care we once passed the needle through the mesenteric border of the intestine.

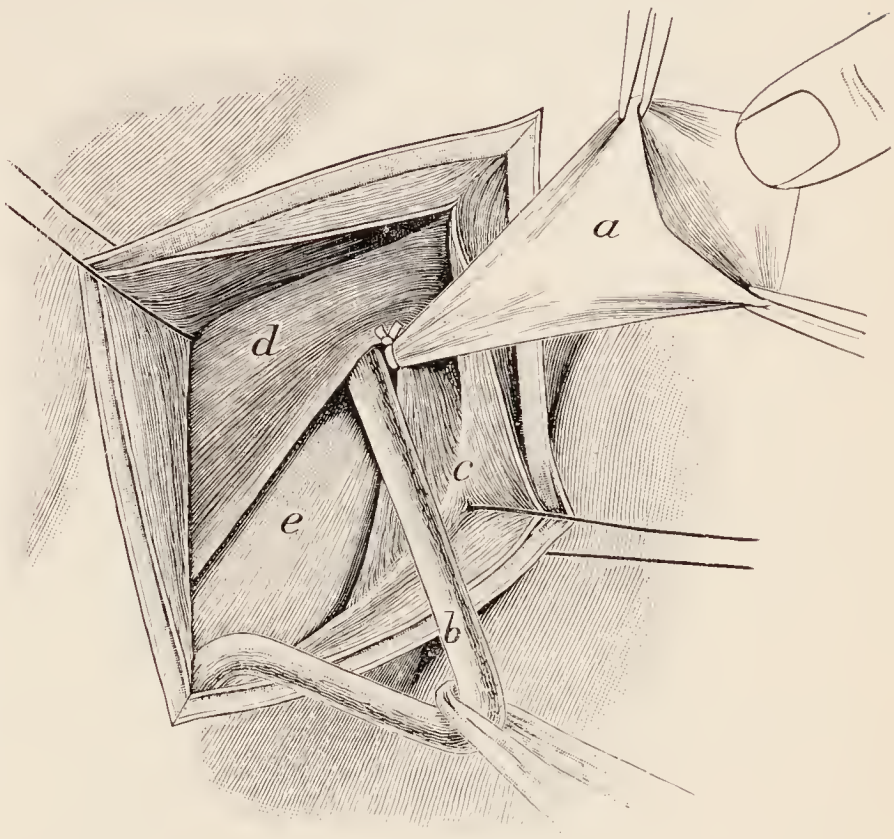



FIG. 1129.—Operation for the radical cure of inguinal hernia, Bassini's method. *a*. Sac dissected from the cord, opened, examined, and neck ligatured. *b*. Cord. *c*. Poupart's ligament. *d*. Arched fibers of internal oblique muscle. *e*. Transversalis fascia.

*The Remarks.*—The separation of the sac from the cord is often very difficult, especially in herniæ of congenital origin. It is even difficult sometimes to detect the presence of the sac, especially in recent and incomplete herniæ. The isolation of the sac is usually best accomplished by beginning at its neck and working downward. If the sac be very thin and illy defined, or difficult of isolation, its presence can be established and isolation facilitated often by the introduction into the sac of the finger through a small incision made for the purpose of guidance and support. The separation of the sac often requires great patience and much care to prevent unwise bruising and tearing of the vascular and fibrous tissues, thus hindering the prompt union so essential to final success. The adhesions between the sac and the contents, and between the contents themselves, must be carefully overcome, and the

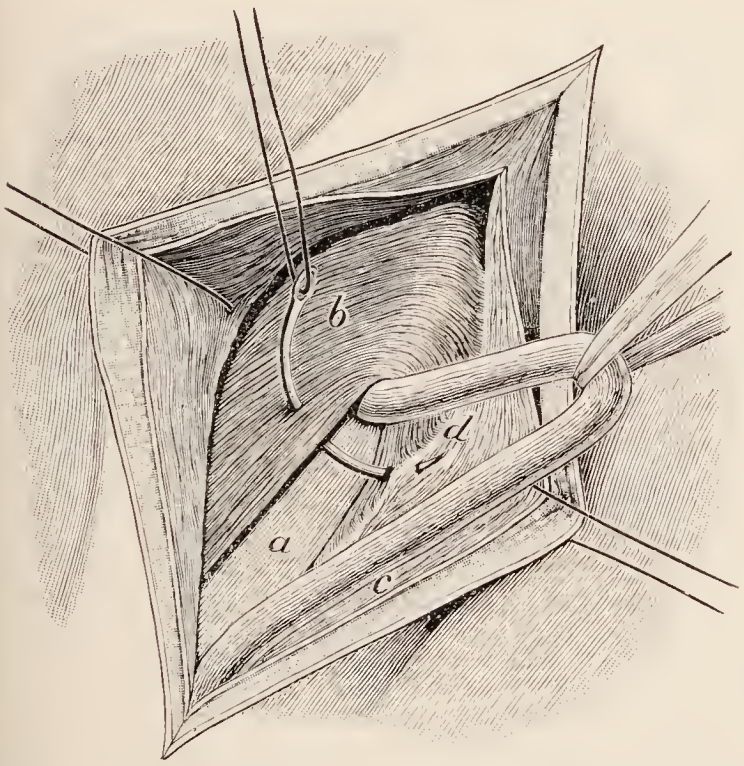
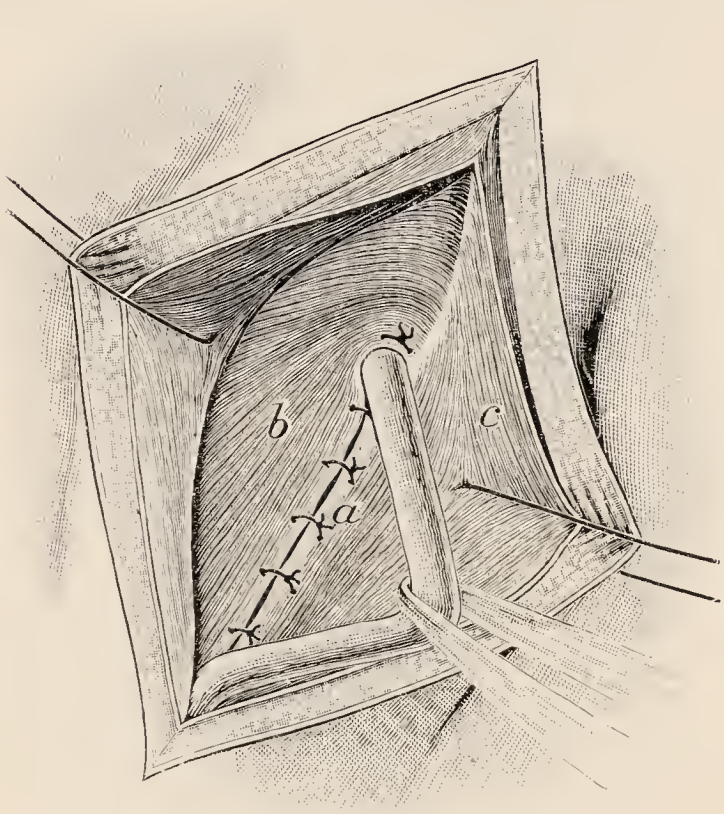



FIG. 1130.—Operation for the radical cure of inguinal hernia, Bassini's method. Sac removed (*c*), cord drawn aside, and stitching of lower fibers of the internal oblique and transversalis muscles (*b*) to Poupart's ligament (*d*) from without inward. *a*. Transversalis fascia.

contents returned to the abdominal cavity before the sac is further treated. The cord can be held out of the way easily with a fold of sterilized gauze while the buried sutures are being placed. Before introducing the kangaroo-tendon sutures, separate with the fingers the lower borders of the internal oblique and transversalis muscles from the transversalis fascia and from the conjoined tendon outward to the internal abdominal ring. In closing the canal from within outward, isolate completely the conjoined tendon and pass



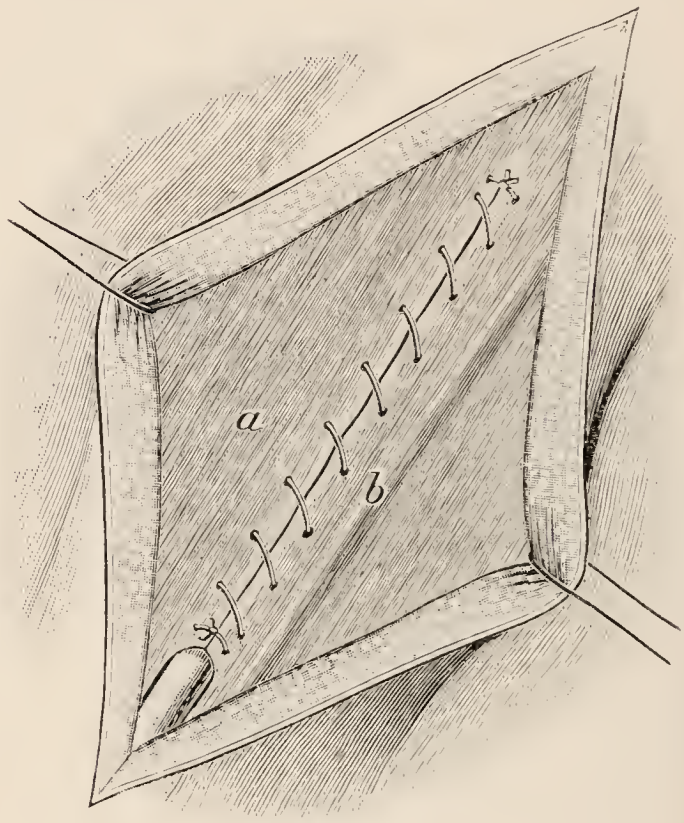




Fig. 1131. Fig. 1132.

Fig. 1131.—Operation for the radical cure of inguinal hernia. Bassini's method. Arched muscular fibers and conjoined tendon (*b*) sewed to Poupart's ligament (*a*). *c*. Aponeurosis of external oblique muscle.

Fig. 1132.—Operation for the radical cure of inguinal hernia, Bassini's method. Aponeurosis of external oblique (*a*) sewed with continuous sutures to Poupart's ligament (*b*).

the end of the index finger behind it; pass a long, curved, dull needle, armed with a kangaroo-tendon suture, through Poupart's ligament just outside the spine of the pubes; carry the needle, guided by the finger, behind the conjoined tendon, thence through its outer border to the front; pass the second suture through Poupart's ligament half an inch or so external to the first, thence along the finger beneath the arched fibers of the internal oblique and transversalis muscles half an inch or so from the first, then forward through the tissues to the front. The latter stitch is repeated until the cord is nearly reached. Sometimes the muscular fibers beyond the internal ring are divided for about an inch (Fig. 1128, *a*), and the cord is pushed outward into the cut to increase the length of the canal and change the direction of the outer end. If this be done an extra suture is required. After closure of the integument the wound may be sealed with collodion. The dressing should be applied firmly along the course of the canal and the hip spica put on with the thigh slightly flexed, so that with extension the dressings are drawn firmly into place and held there until the limb is flexed again.

*The Results.*—*Bassini* reports 251 cases with 7 relapses. *Coley* reports 514 cases of this method with 5 relapses. Coley reports also 600 cases with but a single death, which occurred after 489 consecutive successful operations.

**Halsted's Method of Operation** (*Inguinal Hernia*).—Make an incision from a point 3 centimetres (1.18 inches) beyond and above the internal abdominal ring to the spine of the pubes (Fig. 1133), exposing the aponeurosis of the external oblique and the external abdominal ring; divide the aponeurosis of the external oblique, the fibers of the internal oblique and transversalis muscles, and the transversalis fascia, to a point about an inch above the internal abdominal ring (Fig. 1134); isolate the vas deferens and the blood vessels of the cord (Fig. 1135), and excise all the veins but one or two (Fig. 1136); isolate and open the sac and return the contents to the abdominal cavity; detach thoroughly the upper end of the sac and close it with mattress or continuous sewing with silk, and cut off the sac close to the sutures; raise the cord upward and out of the way and introduce six or eight silver-wire mattress sutures through the aponeurosis of the external oblique, the muscular fibers of the internal oblique and transversalis, and the transversalis fascia, at the upper side and through the transversalis fascia, Poupart's ligament, and the aponeurosis of the external oblique at the lower side of the wound (Fig. 1137). The two outermost sutures pass through muscular tissue at both sides of the wound and between them the cord is permitted to escape; tie the sutures so as to bring the tissues snugly together (Fig. 1138), unite the borders of the aponeurosis of the external oblique muscle with silver-wire mattress sutures (Fig. 1139), and close the skin wound with a fine continuous subcuticular silver-wire suture (Fig. 1140).

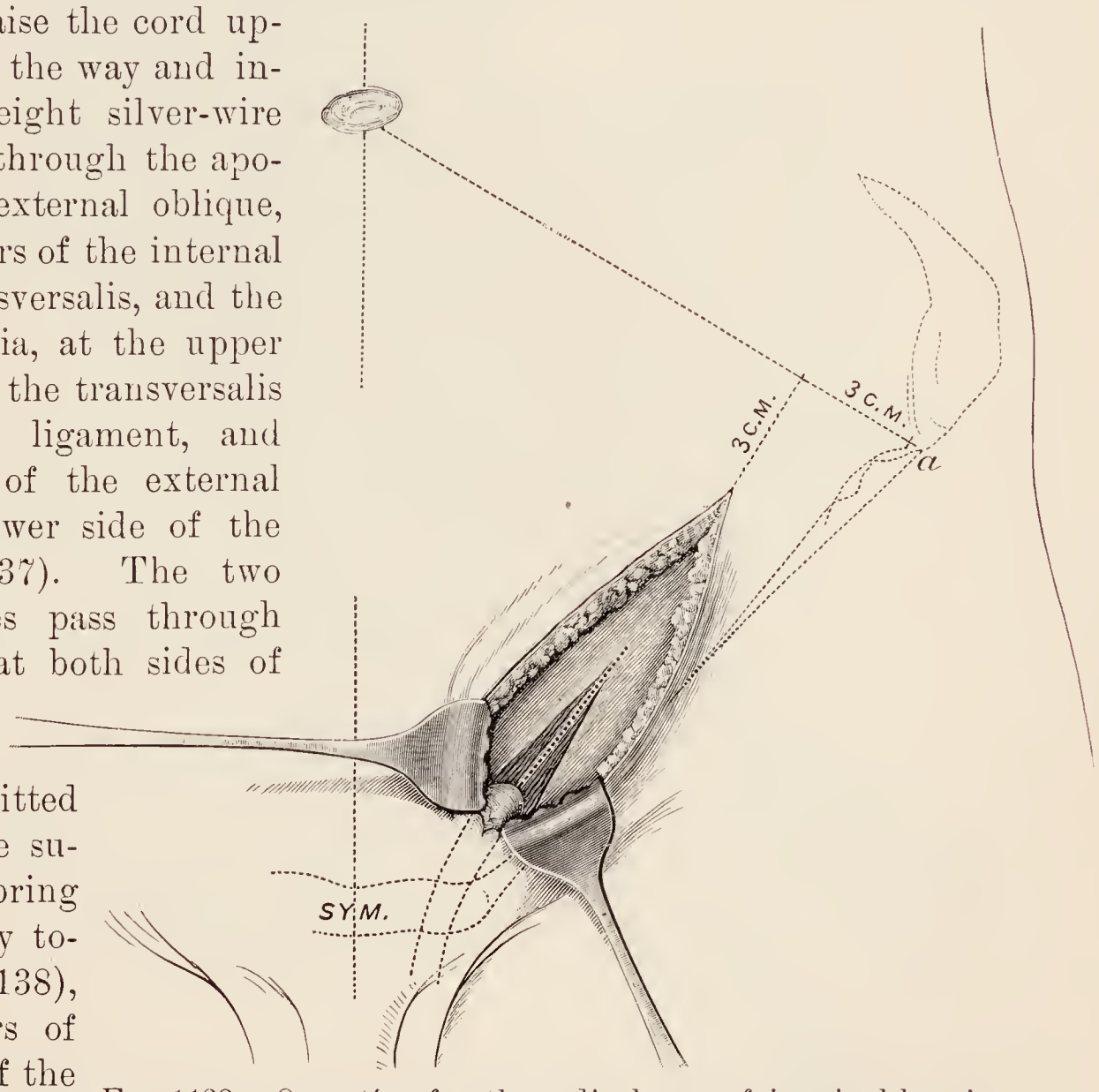



FIG. 1133.—Operation for the radical cure of inguinal hernia, Halsted's method. An anterior superior, spinous process. Skin incision, exposure of external abdominal ring and the cord; line of division of aponeurosis of external oblique muscle (dotted line).

*The Remarks.*—In this operation a new canal and internal ring are formed, the latter fitting the cord snugly. During the closure of the base of the sac by sewing the intestine is retained in place with gauze or a string-attached sponge, and as the sewing progresses the sac can be severed, thus

maintaining better control of the peritoneal borders of the opening. The restraining agent should be withdrawn before the opening is so far closed as to interfere with the act. If the two outer stitches be placed too closely together, the cord will be pinched and the circulation impeded; if too far



Fig. 1134.—Operation for the radical cure of inguinal hernia, Halsted's method. Aponeurosis of external oblique divided and drawn aside, exposing internal oblique and inguinal canal. Upper dotted line shows direction and extent of division of internal oblique muscle. Lower dotted line, the direction and extent of division of the coverings of the sac.

apart, a weakened point will invite the recurrence of hernia. "The precise point to which the cord is transplanted depends upon the condition of the muscles at the internal ring. If they are thick and firm, and present broad, raw surfaces, the cord may be brought out here. But if the muscles be attenuated at this point, and present thin, cut edges, the cord is transplanted farther out."

*Halsted* regards with especial favor the employment of silver wire for suturing, not only because of permanency, but also on account of the influence on germs of the chemic changes incident to association with living tissues.

*The Results.*—In 195 cases 5.6 per cent relapsed in from six months to nine years. With primary union 3.3 per cent relapsed; with secondary, 25 per cent. There seems to be no doubt that occasional atrophy of the testicle follows this method of practice. The following communication of April 28, 1900, from Dr. Halsted to us is expressive of its own significance:

"We still employ silver wire, and find the subcutaneous suture as highly important as ever. The essential points seem to be the following: In over 109 cases in which we have excised the veins of the cord, there has not been a single recurrence at the site of the transplanted cord. The atrophy of the testicle, which occasionally accompanied excision of the veins, we now no longer fear, because we employ great caution in excising these veins. We do it with a sharp knife, making very careful dissection so as to injure no

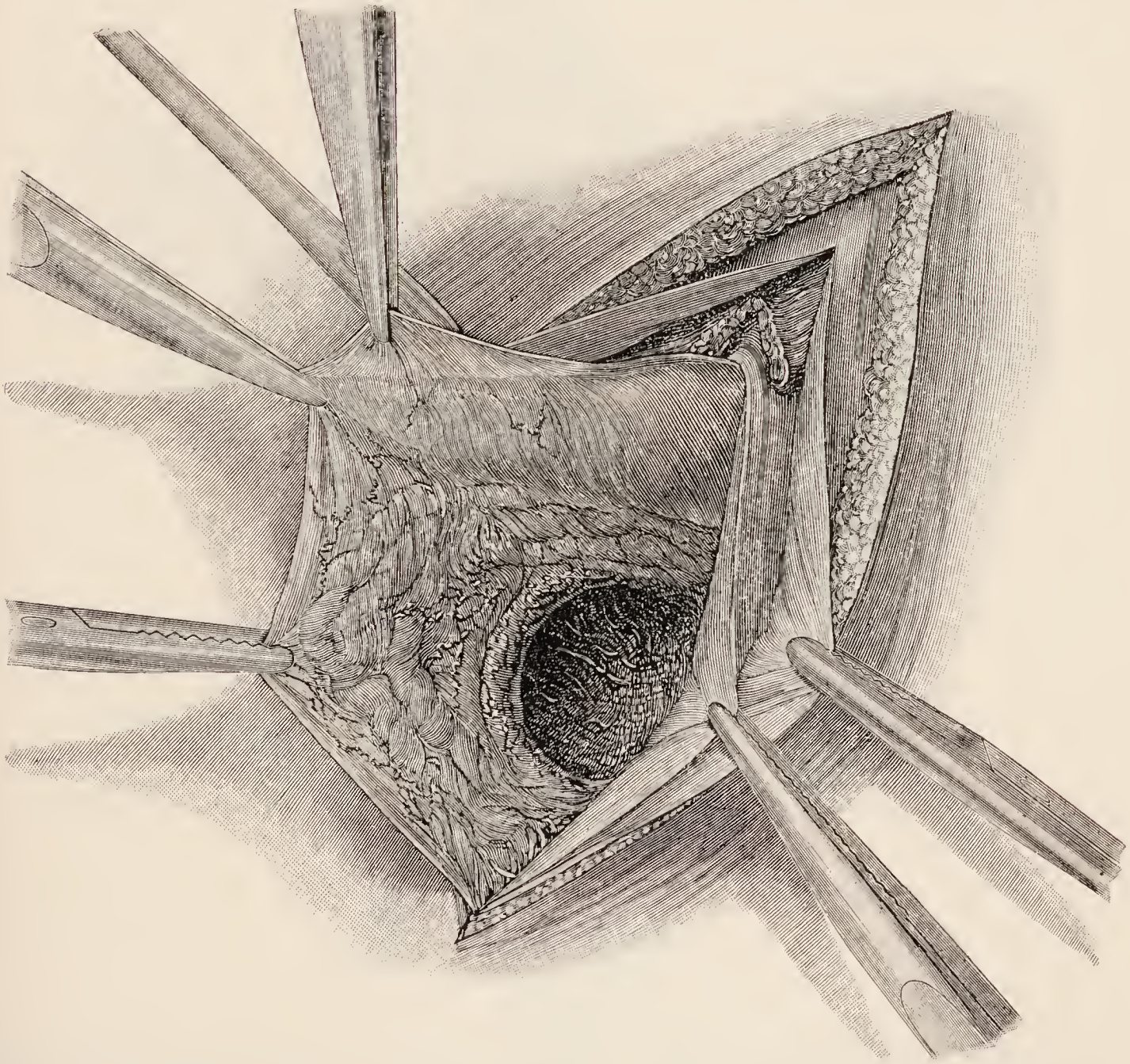


FIG. 1135.—Operation for the radical cure of inguinal hernia, Halsted's method. The internal oblique muscles and coverings of sac have been divided. The sac, veins, and vas deferens drawn out preparatory to excision of sac; ligature and excision of the veins.

blood-vessels. As a rule, I do not transplant the vas deferens, but we are still, in the majority of cases, splitting the internal oblique muscle and lining the wound with it. Bloodgood discovered that we had a certain percentage of recurrences in the lower angle of the wound, and devised an

operation to remedy this. I know of but two recurrences since we have been using the present method: one in the case of a very old man with a very large double hernia, operated on both sides with cocain; and the other, in

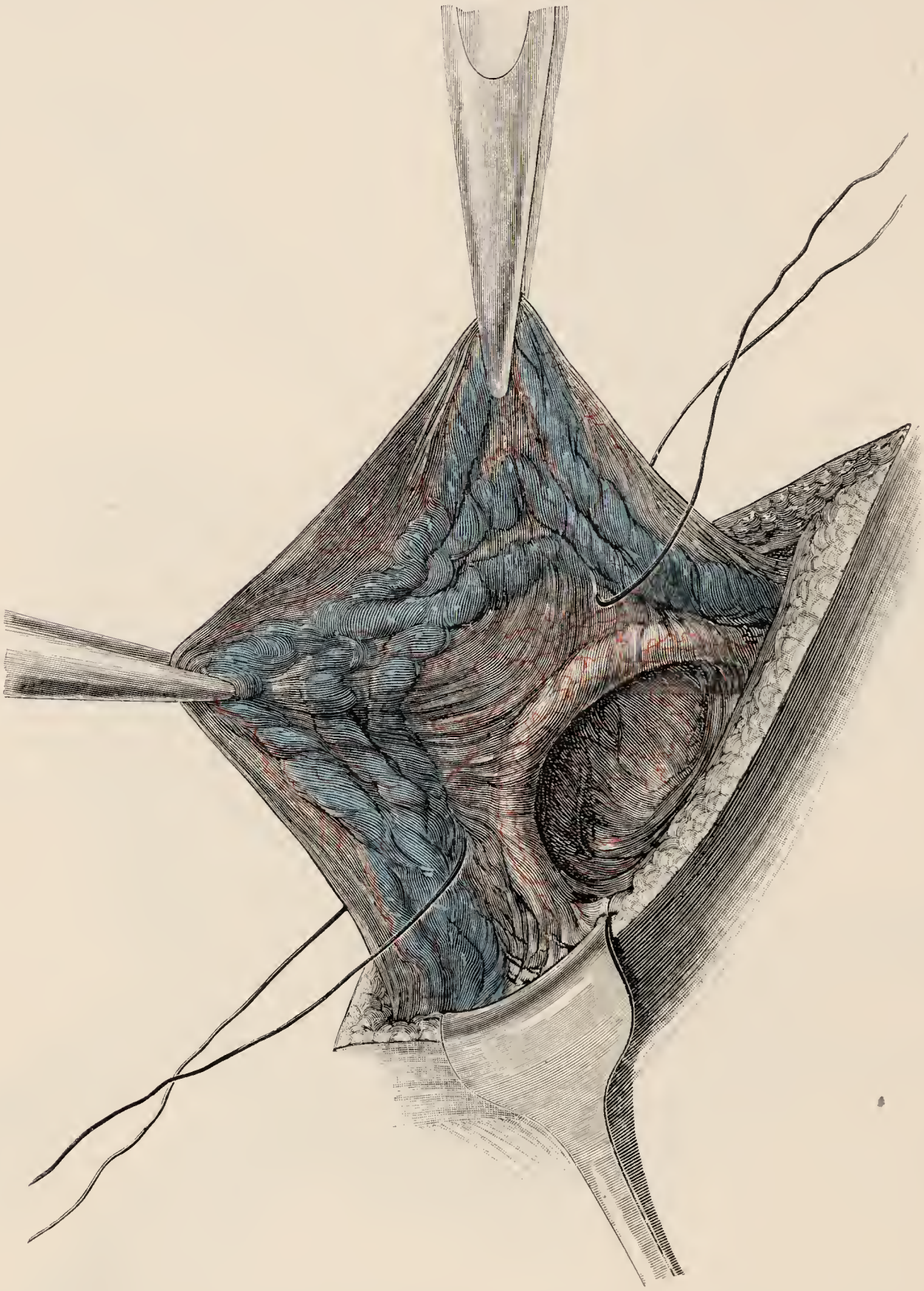


FIG. 1136.—Operation for the radical cure of inguinal hernia, Halsted's method. The excision of veins in hernia and in varicocele. The vas deferens and its immediate vessels and the mesocord not disturbed.

which there is a slight weakness in the scar, caused, we think, perhaps, by the breaking of a stitch at this point. It is only in a small proportion of cases that we find it necessary to transplant a portion of the rectus muscle."

*Bloodgood's Modification.—Bloodgood*, noting the occasional defective state of the conjoined tendon due to either acquired or congenital causes,

sought to strengthen that part of the anatomy by transplantation of a portion of the rectus muscle, which is done in the following manner: Before inserting the deep sutures for closure of the canal draw upward and inward the aponeurosis of the external and internal oblique muscles, thus exposing the sheath of the rectus muscle; divide the sheath at the outer border of the muscle from below upward for about two inches; pass through the bulging border of the muscle two or three large black silk traction sutures, and draw the border outward and downward (Fig. 1141); pass the deep sutures of silver wire (Fig. 1142) the same as before (in Halsted's method), so that they will include in proper order the sheath and fibers of the rectus along with the other tissues; tie the sutures, thus uniting to

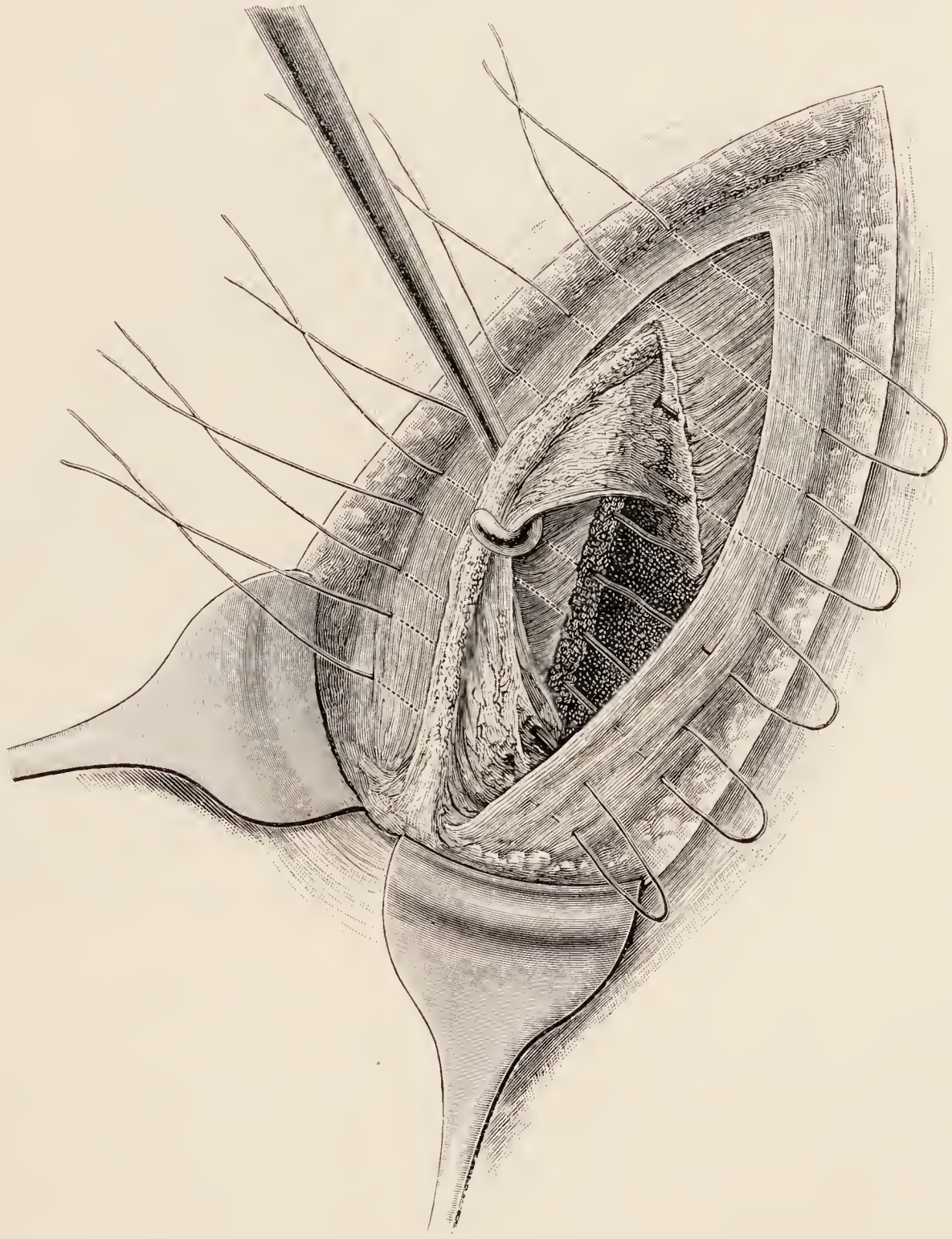


Fig. 1137.—Operation for the radical cure of inguinal hernia, Halsted's method. Veins ligatured and resected. Mesocord torn only at its center. Silver sutures inserted, one above and four below the cord.

Poupart's ligament the border of the rectus from the symphysis to a point corresponding to the outer limit of the transplanted cord (Fig. 1143).

*The Remarks.*—This modification, while originally supplementary to Halsted's method, can be applied to others in which the canal is freely laid open.

*The Results.*—In 30 cases thus far reported not a relapse has taken place. There now appears to be no reasonable doubt of the fact that this expedient

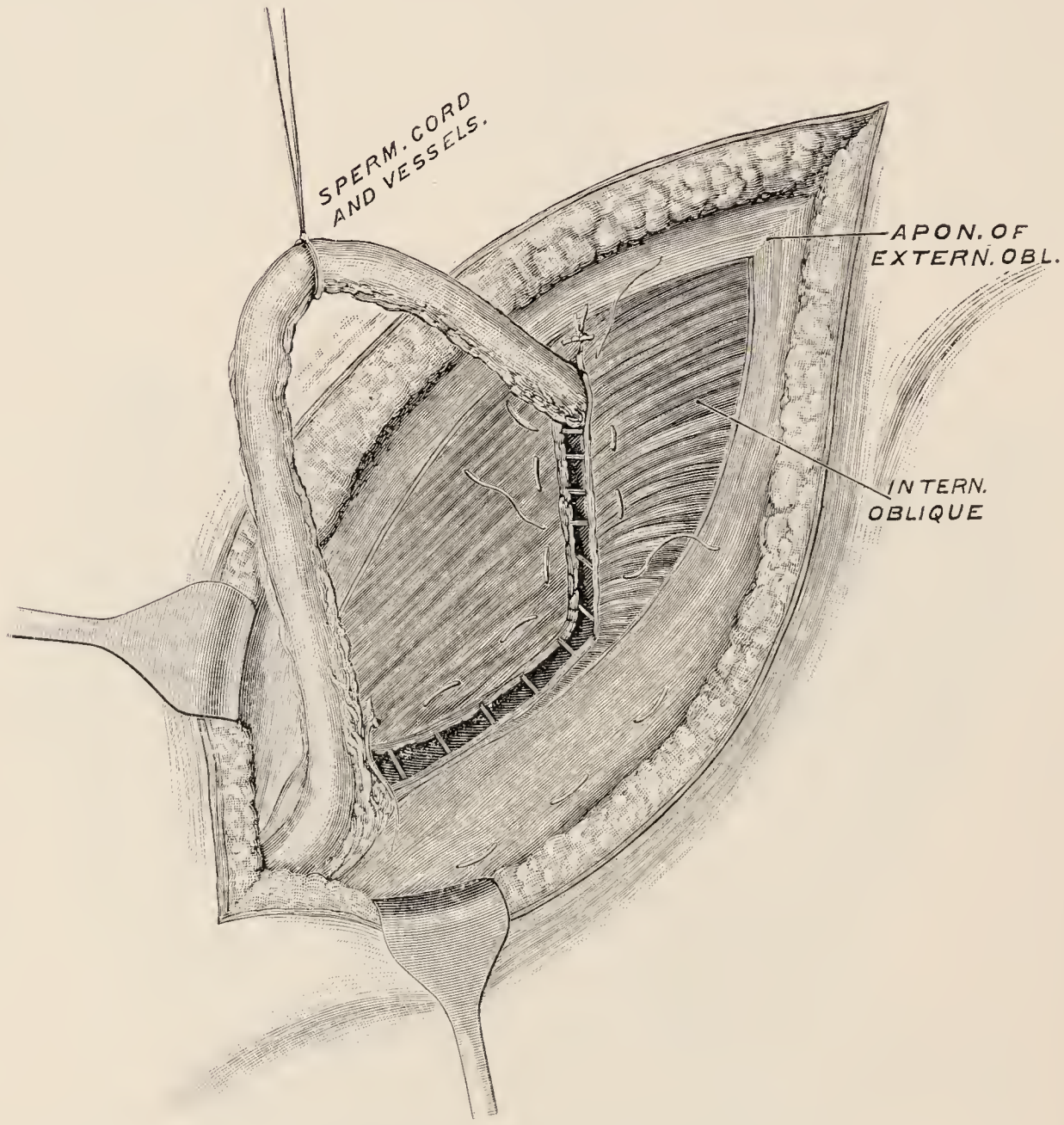



FIG. 1138.—Operation for the radical cure of inguinal hernia, Halsted's method. Outer two thirds made secure by transplantation and approximation of muscular borders. If conjoined tendon be narrow or frail the inner third is protected by transplantation of borders of the rectus abdominis.

can be safely utilized and confidently trusted. Slajmer reports 12 per cent relapses within six months to five years (Wölfer).

**Lucas-Championnière's Method** (*Inguinal Hernia*).—Make an incision three or four inches in length parallel with and half an inch above Poupart's ligament into the inguinal canal; separate the sac from the cord, and ligature the sac well above the neck, leaving the cord lying in the canal; close the canal with a series of mattress sutures placed in such a manner as to cause the muscles at the upper border of the canal to overlap the lower border. *a*, *b*, *c*, *d* indicate the musculo-aponeurotic upper flap; *e*, *f*, *g*, *h* the aponeurotic lower flap; *1*, *2*, *3*, *4* indicate catgut sutures inserted first, and at the edge of the lower flap. The ends of these sutures are passed under and well up and through the upper flap and tied, thus bringing border

*e*, *f* of the lower flap to the dotted line *e*, *f*, as noted in Fig. 1144. The border *c*, *d* of the upper flap is brought down by similar sutures and fastened to Poupart's ligament, *c*, *d*.

*The Results.*—Championnière himself reports that of 650 cases but 4 died from the operation, and, as far as could be ascertained, 22 relapses had occurred.

**Kocher's Method** (*Inguinal Hernia*).—Make an incision a finger's breadth above, parallel with, and corresponding to the inner two thirds of Poupart's ligament, down to the aponeurosis of the external oblique; expose the aponeurosis along the line of incision; expose the hernial sac at the external ring (Fig. 1145) by extension downward of the primary incision, and careful division of the several tissues lying above it; isolate the sac at this situation in the usual manner from the structures of the cord, and carefully separate



Fig. 1139.

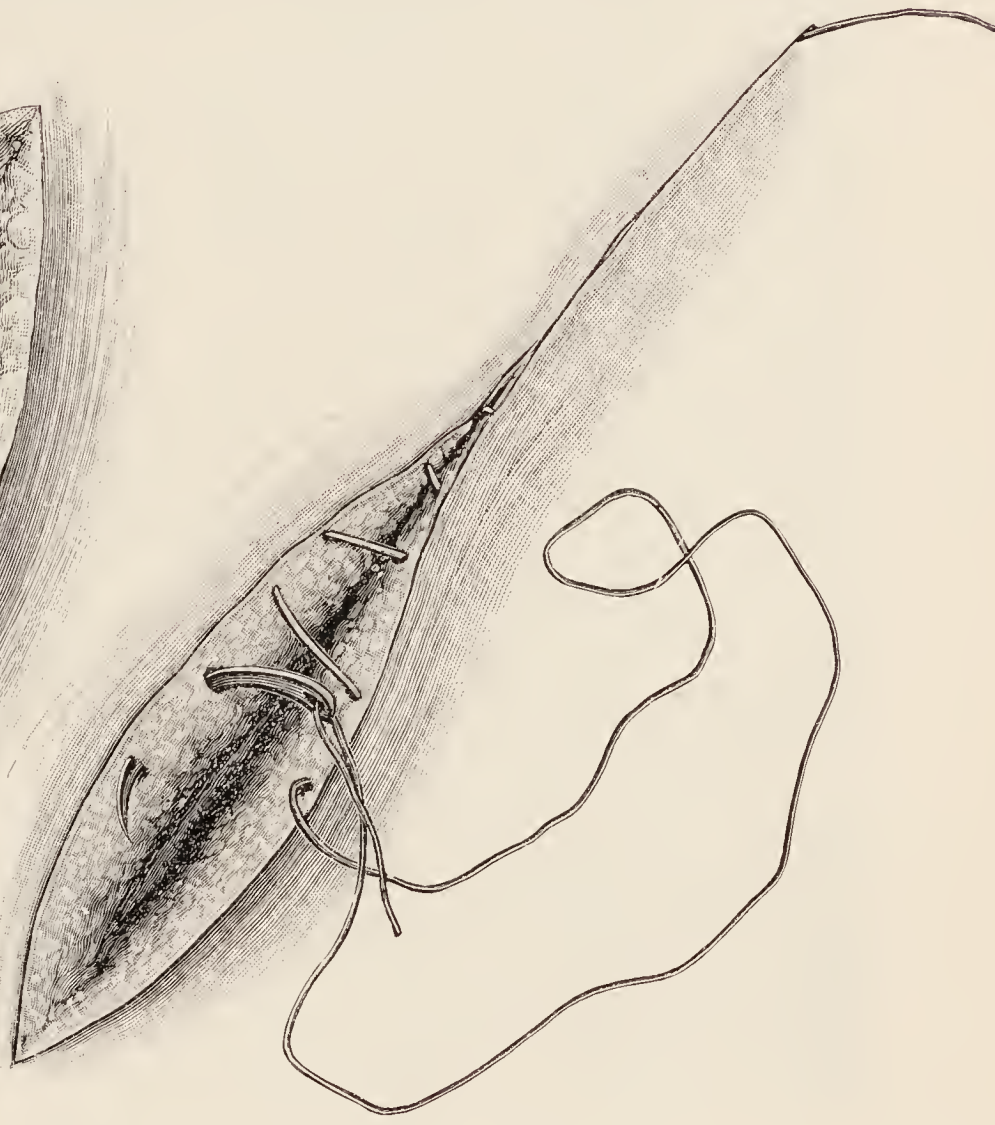


Fig. 1140.

Fig. 1139.—Operation for the radical cure of inguinal hernia. Halsted's method. Aponeurosis of external oblique closed by silver-wire mattress sutures, ends bent down and buried.

Fig. 1140.—Operation for the radical cure of inguinal hernia, Halsted's method. The introduction of the subcuticular continuous wire suture. The suture is carefully withdrawn after suitable union is secured.

and withdraw it from the scrotum (Fig. 1146); separate the sac from the tissues above while drawing downward firmly upon it, until the part of the sac that occupied the internal abdominal ring is exposed; reduce and retain in position the contents of the sac; transfix the upper limit of the sac with a needle armed with a strong silk ligature and tie in halves; make a small open-

ing through the aponeurosis above and external to Poupart's ligament (Fig. 1145); introduce through the opening (*a*) and push along the under surface of

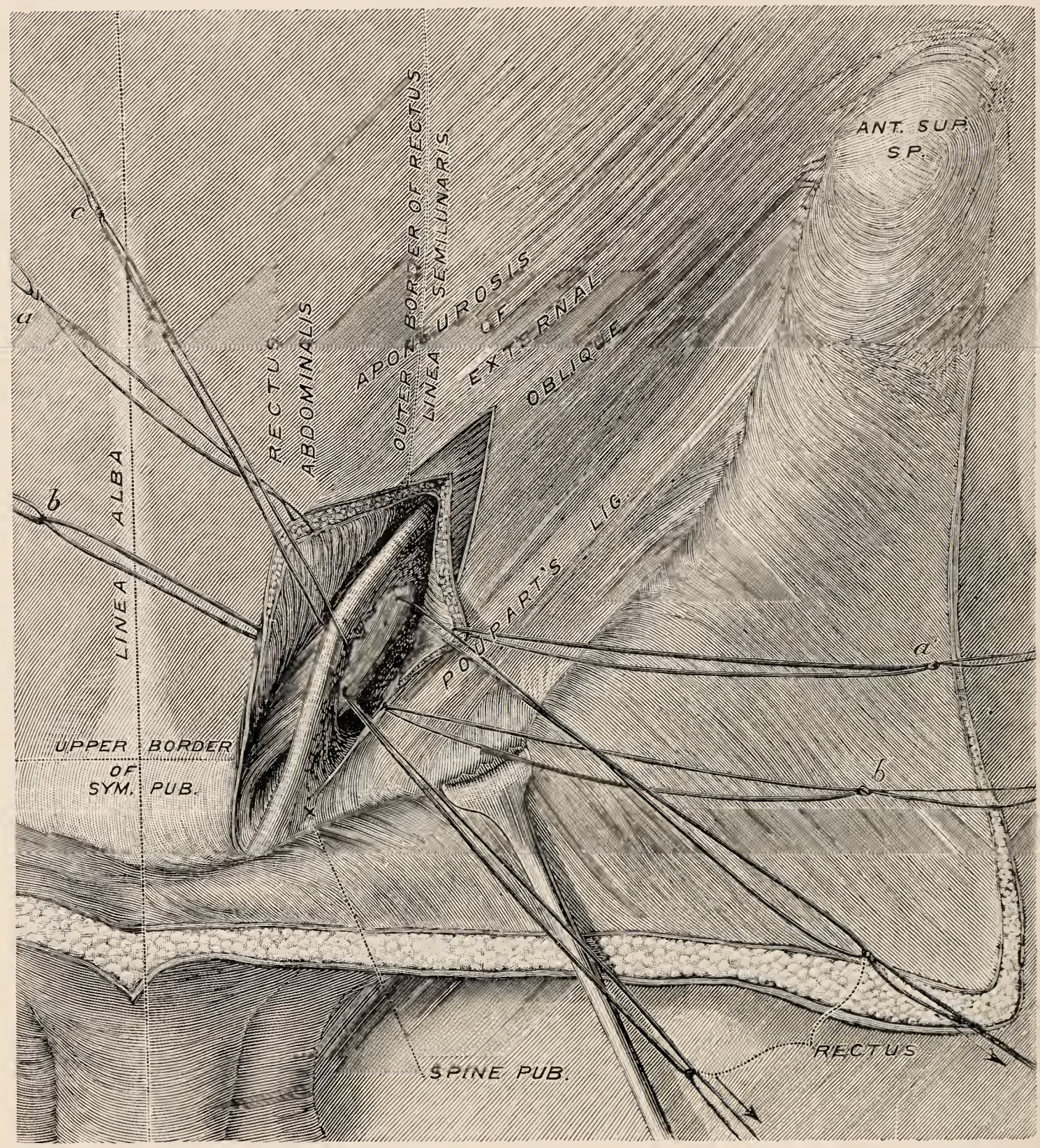



FIG. 1141.—Operation for the radical cure of inguinal hernia, Bloodgood's modification of Halsted's method. Sac excised and peritoneal cavity closed; internal oblique muscle divided, rectus exposed and transplanted inward, ready for deep sutures. *a*, *a'*. Traction loops applied to divided borders of the internal oblique muscle. *b*, *b*. Traction loops applied to borders of aponeurosis of external oblique muscle. *c*. Cord raised permitting passage of the border of the rectus.

the aponeurosis, through the external abdominal ring, a long, curved dressing forceps (Fig. 1146); seize the fundus of the sac with the forceps and withdraw it, dragging the sac upward through the opening (Fig. 1147); draw upward and outward on the sac away from the cord, pulling the neck of the sac well into the aponeurotic incision; transfix and sew the neck of the sac to the abdominal wall; turn the sac downward on the aponeurosis along the course of the inguinal canal; introduce the finger into the canal to protect

the cord, while several sutures are passed as deeply as possible through the aponeurosis and sac in the manner shown (Fig. 1148), and tied firmly; cut away the remainder of the sac, and pass a deep suture through the borders of the internal ring close to and beneath the neck of the sac; finally, so pass several sutures through the lower fibers of the internal oblique and transversalis muscles as to narrow the inguinal canal and fortify it in front when tied.

*The Modification.*—Carry the sac outward and upward—instead of downward on the aponeurosis—toward the anterior iliac spine, and sew it to the

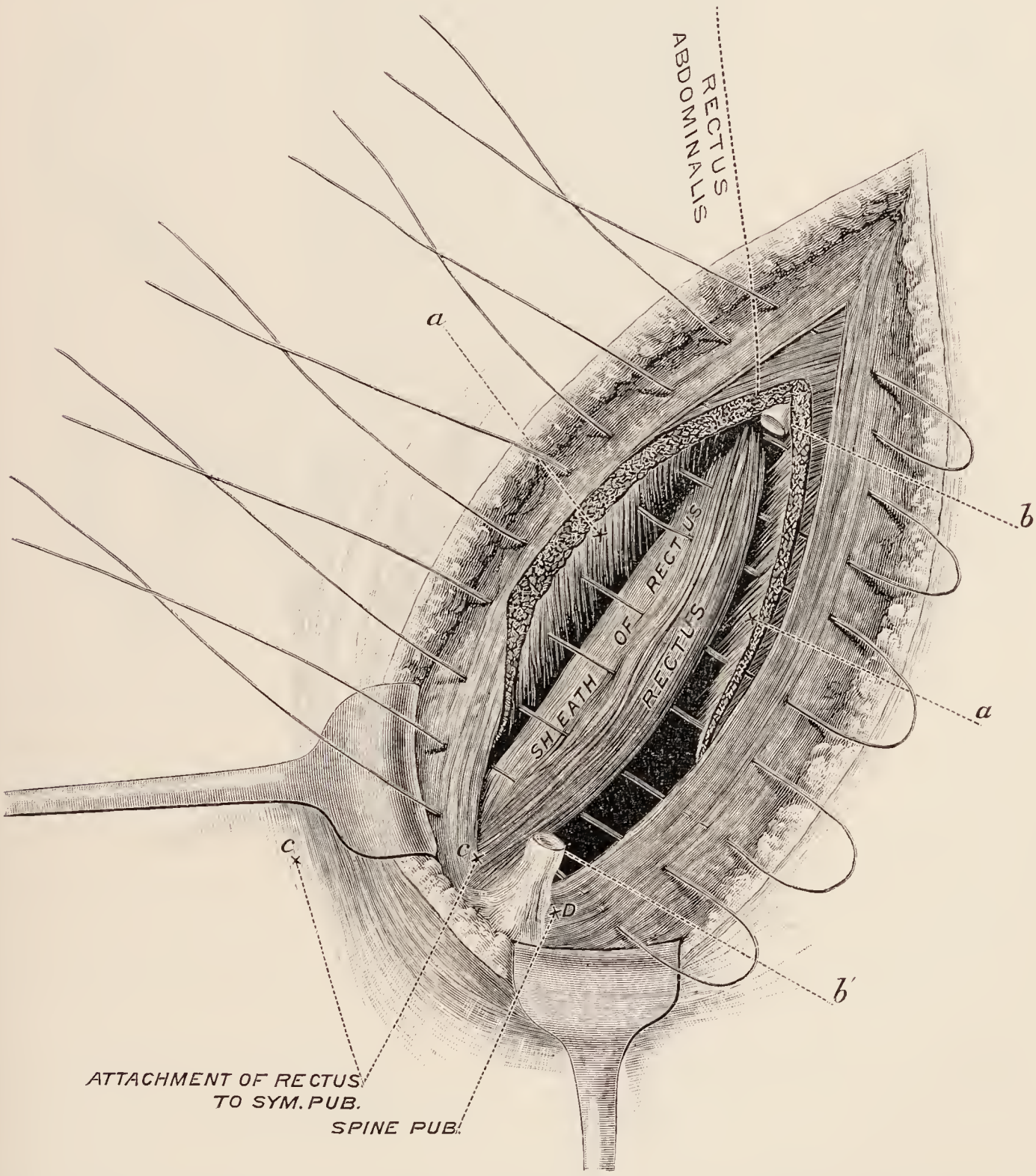



FIG. 1142.—Operation for the radical cure of inguinal hernia, Bloodgood's modification of Halsted's method. Cord removed so as not to obscure demonstration. *a*, *a*. Divided borders of internal oblique muscle. *b*, *b*.′ Ends of resected cord.

aponeurosis of the external oblique, and thus draw the peritonæum still further outward, and make it impossible for a hernia to escape along the course of the cord (Kocher).

*The Remarks.*—This method is applicable to those cases in which the sac is not too large nor too thick to lead to impairment of the strength of the anterior wall of the canal. In the instances of incomplete herniæ it is

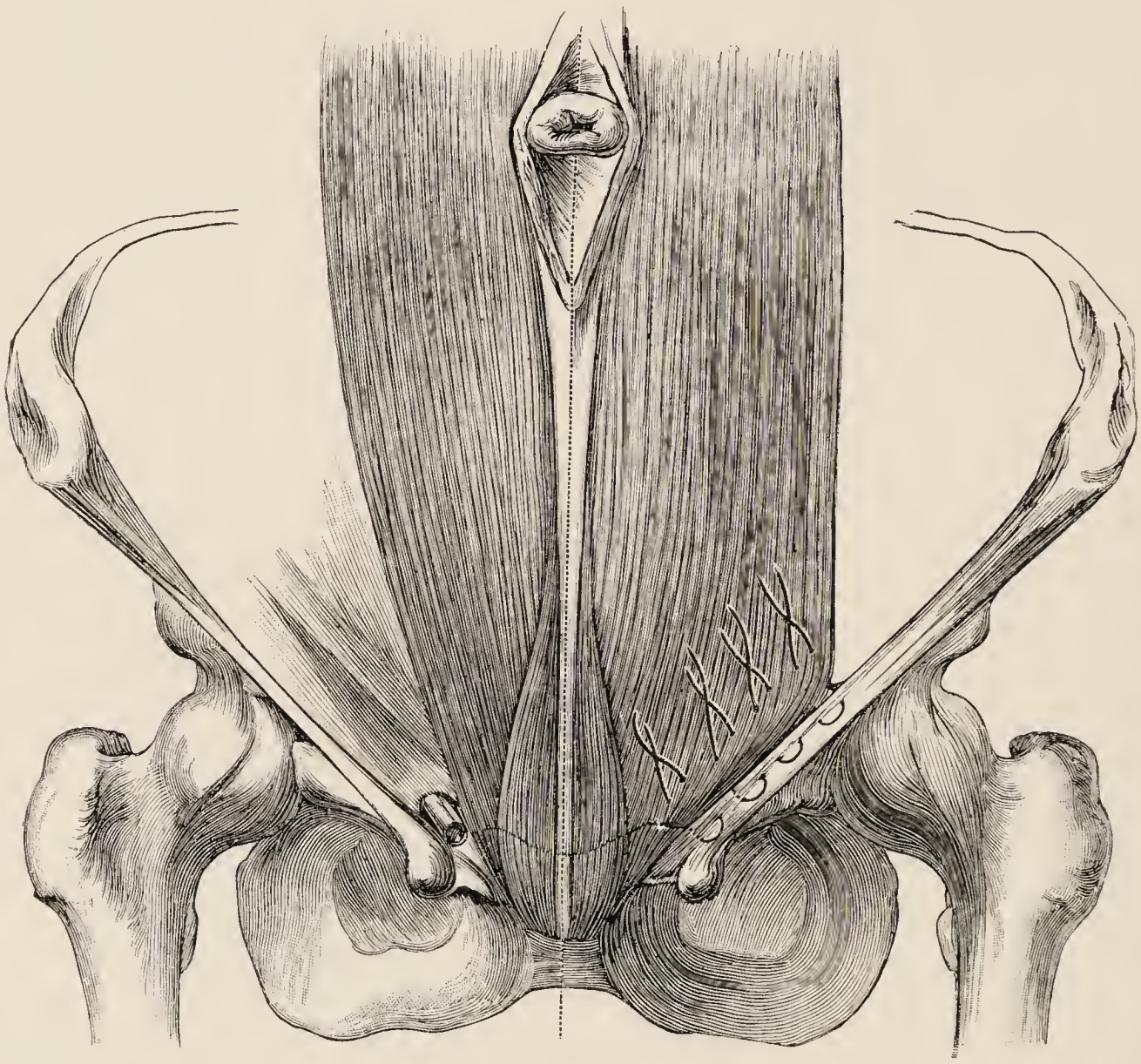


Fig. 1143.—Operation for the radical cure of inguinal hernia, Bloodgood's modification of Halsted's method. The transplanted border of the rectus united to Poupart's ligament, showing slight change in the direction of its fibers.

better to employ another method of practice. During the passage of the final sutures directed to narrowing the canal careful attention is necessary to avoid puncture and perhaps inclusion of the cord.

*The Results.*—In 111 operations no death ensued; recurrence happened in 3.6 per cent of the cases within from six months to two years and upward.

**Macewen's Method** (*Inguinal Hernia*).—*Macewen's* operation for radical cure of hernia is one of the best of the earlier methods practiced, and before the advent of the more modern methods it was regarded more highly in this country than any other plan of procedure. After exposure of the inguinal canal and internal ring the operation is divided into two steps: 1, the formation of an abdominal serous pad; 2, the closure of the inguinal canal. The following description is in Macewen's own language:

"A. *The Formation of a Pad on the Abdominal Surface of the Circumference of the Internal Ring.*—1. Free and elevate the distal extremity of the sac, preserving along with it any adipose tissue that may be adherent to

it; when this is done, pull down the sac, and, while maintaining tension upon it, introduce the index finger into the inguinal canal (Fig. 1149), separating the sac from the cord and from the parietes of the canal.

"2. Insert the index finger outside the sac until it reaches the internal ring; there separate with its tip the peritonæum for about half an inch round the whole abdominal aspect of the circumference of the ring.

"3. A stitch is secured firmly to the distal extremity of the sac. The end of the thread is then passed in a proximal direction several times through the sac, so that, when pulled upon, the sac becomes folded upon itself, like a curtain (Fig. 1150).

"The free end of this stitch, threaded on a hernia needle, is introduced through the canal to the abdominal aspect of the fascia transversalis, and there penetrates the anterior abdominal wall about an inch above the upper border of the internal ring. The wound in the skin is pulled upward, so as to allow the point of the needle to project through the abdominal muscles without penetrating the skin (Fig. 1151).

"The thread is relieved from the extremity of the needle when the latter is withdrawn. The thread is pulled through the abdominal wall; and, when traction is made upon it, the sac, wrinkling upon itself, is thrown into a series of folds, its distal extremity being drawn farthest backward and upward. An assistant maintains traction upon the stitch until the introduction of the sutures into the inguinal canal; and, when this is completed, the end of the stitch is secured by introducing its free extremity several times through the superficial layers of the external oblique muscles. A pad of peritonæum is thus placed upon the abdominal side of the internal opening, where, owing to the abdominal aspect of the circumference of the internal ring having been refreshed, new adhesions may form.

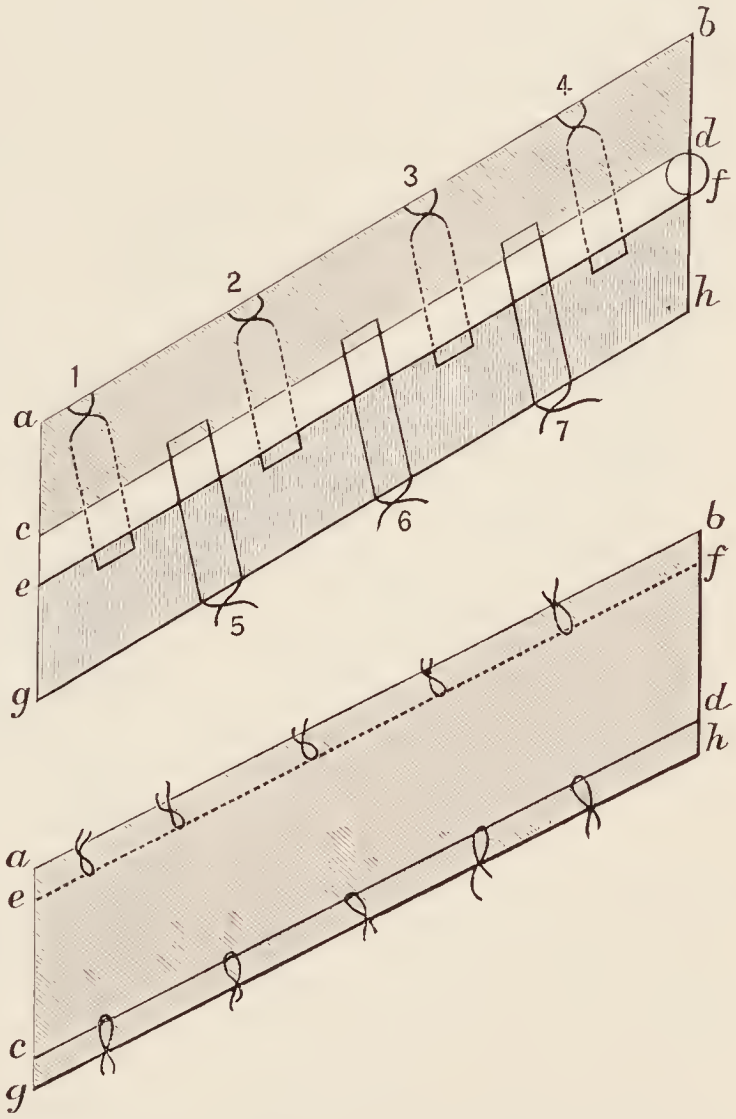



FIG. 1144.—Operation for the radical cure of inguinal hernia, Lucas-Championnière's method.

"B. *Closure of the Inguinal Canal.*—The sac having been returned into the abdomen and secured to the abdominal circumference of the ring, this aperture is closed in front of it in the following manner: The finger is introduced into the canal, and lies between the inner and lower borders of the internal ring, in front of and above the cord. It makes out the position of the epigastric artery so as to avoid it. The

threaded hernia needle is then introduced, and, guided by the index finger, is made to penetrate the conjoined tendon in two places (Fig. 1152): First, from without inward, near the lower border of the conjoint tendon; secondly, from within outward, as high up as possible on the inner aspects of the canal. This double penetration of the conjoint tendon is accomplished by a single screwlike turn of the instrument. One single thread is then withdrawn from the point of the needle by the index finger, and, when this is accomplished, the needle, along with the other extremity of the thread, is removed. The conjoint tendon is therefore penetrated twice by this thread, and a loop left on its abdominal aspect (Fig. 1153).

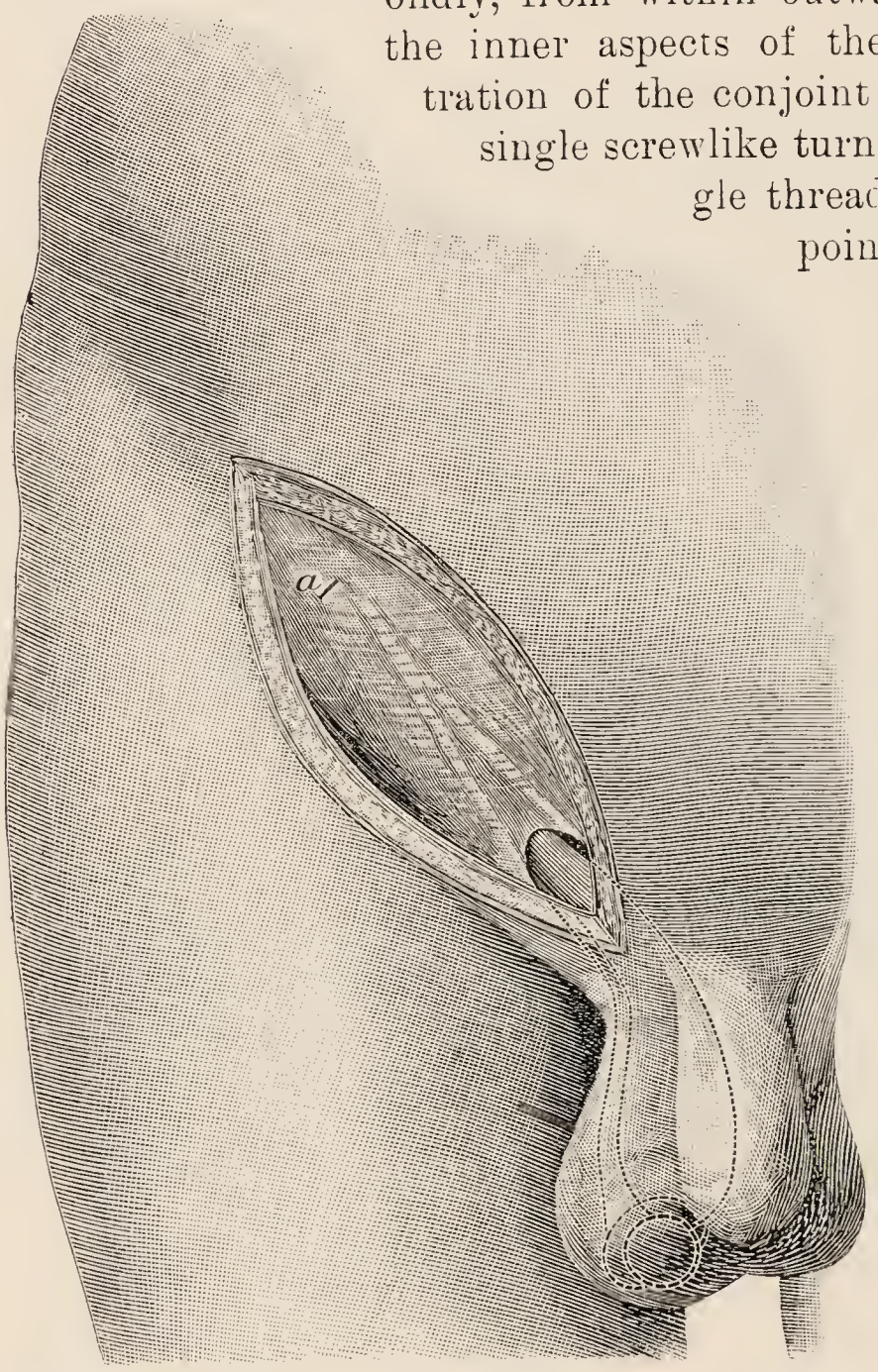



FIG. 1145.—Operation for the radical cure of inguinal hernia, Kocher's method. Exposure of the aponeurosis of the external oblique muscle, of the external abdominal ring, and the cord. Short, transverse incision (*a*) opening for introduction of forceps.

"The other hernia needle, threaded with that portion of the stitch which comes from the lower border of the conjoint tendon, guided by the index finger in the inguinal canal, is introduced from within outward, through Poupart's ligament, which it penetrates at a point on a level with the lower stitch in the conjoint tendon (Fig. 1154). The needle is then completely freed from the thread and withdrawn.

"The needle is now threaded with that portion of the catgut which protrudes from the upper border of the conjoint tendon, and is introduced from within outward through the transversalis and internal oblique muscles, and the aponeurosis of the external oblique at a level corresponding with that of the upper stitch in the conjoint tendon. It is then quite freed from the thread and withdrawn (Fig. 1155).

"There are now two free ends of the suture on the outer surface of the external oblique, and these are continuous with the loop on the abdominal aspect of the conjoint tendon (Fig. 1155). To complete the suture the two free ends are drawn tightly together and tied in a reef knot. This unites firmly the internal ring.

"The same stitch may be repeated lower down the canal if thought desirable. In adults it may be well to do so when the gap in the abdominal

parietes is wide. The pillars of the external ring may likewise be brought together.

"In order to avoid compression of the cord, it ought to be examined before tightening each stitch. The cord ought to lie behind and below the sutures, and be freely movable in the canal. It is advisable to introduce all the necessary sutures before tightening any of them. When this is done, they might be all experimentally drawn tight, and maintained so while the operator's finger is introduced into the canal to ascertain the result. If satisfactory, they are then tied, beginning with the one at the internal ring, and taking up in order any others which may have been introduced. In the great majority of cases the stitch in the internal ring is all that is required.

"During the operation the skin is retracted from side to side, to bring the parts into view and to enable the stitches to be fixed subcutaneously. When the retraction is relieved, the skin falls into its normal position, the wound being opposite the external ring. The operation is therefore partly subcutaneous."

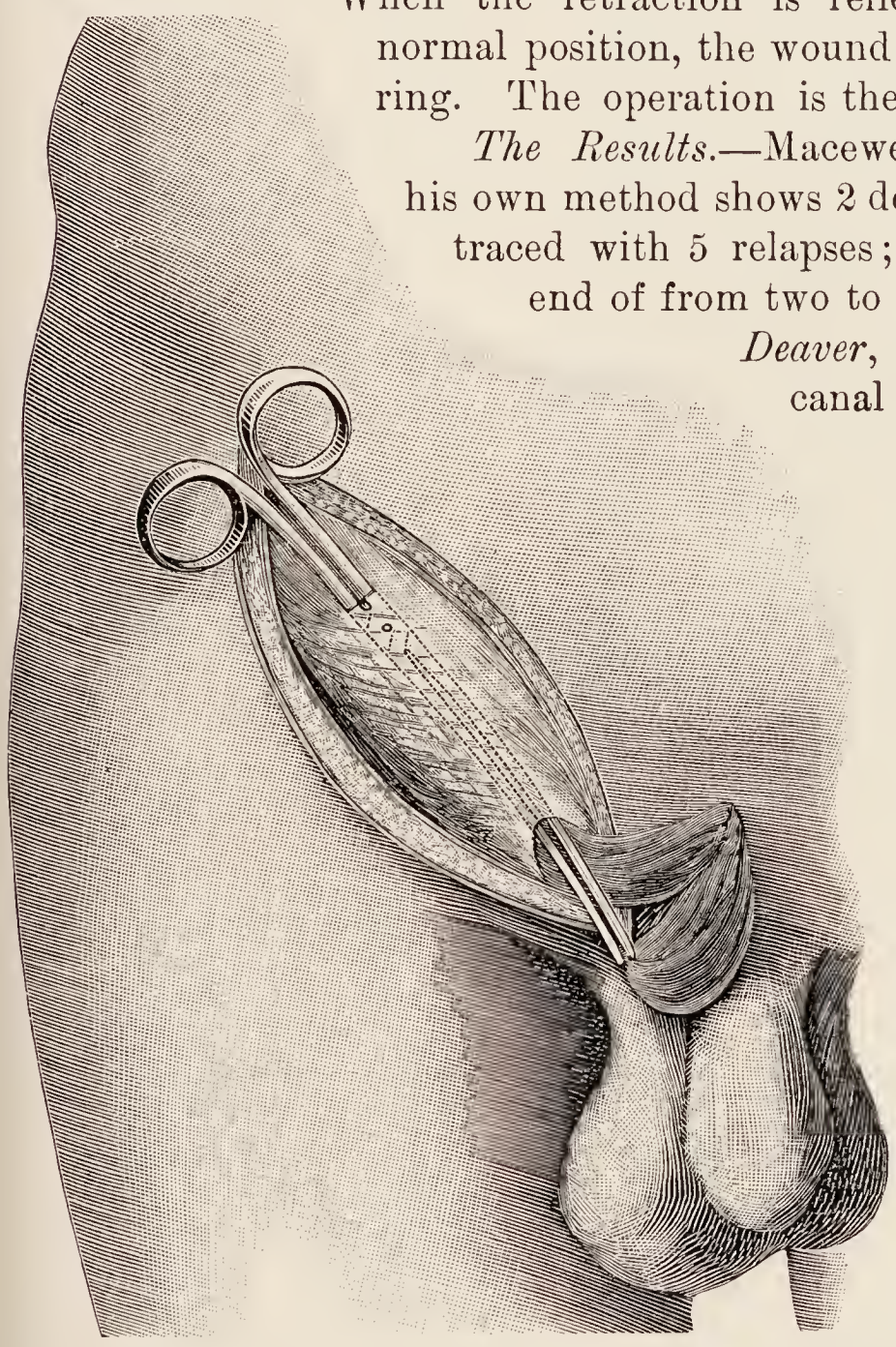


FIG. 1146.—Operation for the radical cure of inguinal hernia, Kocher's method. Sac separated and end seized by forceps passed through the transverse incision (*a*) down the inguinal canal.

*The Results.*—Macewen's personal experience in his own method shows 2 deaths in 164 cases; 107 were traced with 5 relapses; 93 cases were cured at the end of from two to ten years.

*Deaver*, after opening the inguinal canal through the usual free incision, exposes and separates the hernial sac the entire length, makes a small opening into it, frees the sac of adhesions within, reduces the contents into the abdominal cavity, folds the sac upon itself, carries it into position beneath the peritonæum, placing it at the site of the internal abdominal ring, and fastens it there by sutures to the abdominal wall. He then closes the canal from within outward by means of interrupted (not mattress) silver sutures introduced substantially into the tissues, after the manner of Halsted. This modification adds to the Bassini and Halsted methods the subperitoneal pad of Macewen. Since only theoretical claims appear as yet, the assumed advantages of the proposition await practical demonstration.

*Fowler* presents a modification which, while adding to the dangers of operation, certainly appears to offer increased advantages; but whether or not these qualities are mutually commensurate experience only can determine.

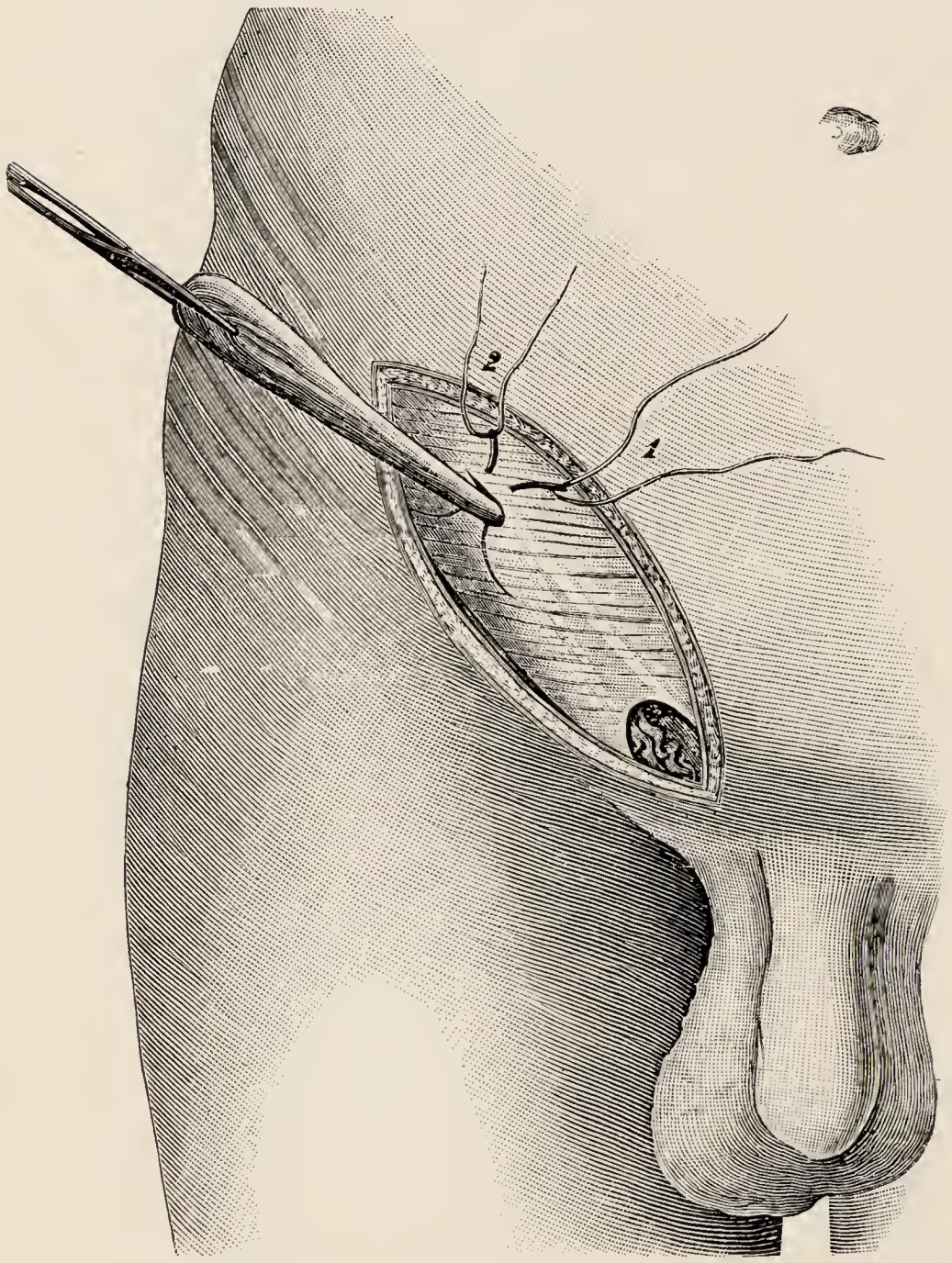



FIG. 1147.—Operation for the radical cure of inguinal hernia, Kocher's method. Sac drawn out through short transverse incision. Transfixion of upper limit of sac with silk ligature.

The purpose of the operation is to obliterate the internal ring, which is accomplished as follows: Expose the inguinal canal out to the internal ring by division of the overlying structures; isolate the cord and sac from the surrounding tissues and from each other to the internal ring; open the sac and reduce the contents; cut off the sac at the neck, grasping the divided borders with forceps; draw the cord out of the way; locate, isolate, and divide the deep epigastric vessels between two ligatures; introduce the index finger through the opening at the neck of the sac into the peritoneal cavity and carry it along the posterior wall of the canal; press the finger forward to make the tissues tense and divide them from without inward on the finger; place the cord within the peritoneal cavity, while carefully preventing the escape of intestines; beginning outside of the internal ring, approximate broadly the serous surfaces along the divided borders and unite them with each other by through-and-through sutures passed from side to side; close and obliterate the inguinal canal, and unite the borders of the external wound respectively with absorbable sutures.

*The Remarks.*—Fowler suggests in those instances in which the internal ring is greatly enlarged in all directions, a slit be made at the lower border, so that the cord will enter more readily the abdominal cavity. During the sewing of the peritonæum and the superimposed fascia, any previous undue relaxation of these tissues can be remedied. The inner angle of the wound should be low enough to cause slight curving of the cord upward and forward as it passes out, permitting it, however, to escape unconstricted because of change in direction or sewing.

*Other Methods of Practice.*—The methods of Ball, Banks, Barker, Bennett, and others have each contributed much indeed to the final outcome of relief, and each would receive extended mention if circumstances required and time and opportunity approved.

*The General Precautions.*—The vas deferens should be carefully preserved from injury for obvious reasons. The separation of the sac from the structures of the cord should be cautiously practiced to avoid unnecessary mutilation and subsequent necrosis of the tissues. It is often wiser to separate the sac from the cord by tearing at the points of great adhesion than to endeavor to separate the structures. In tying the neck of the sac, transfixion should be practiced in order to keep the ligature in proper place after the sac is cut away and intra-abdominal pressure is brought to bear upon it. Mattress sutures meet the same indication. Careful inspection of the interior of the sac should be practiced before ligaturing to note if it be free of abdominal contents. Twisting of the sac; passing the fingers and thumb from above downward on the outside; introduction of the finger to press back the contents, and tying of the sac across the end of the finger as it is withdrawn are each good methods of practice to prevent the inclusion of unwelcome contents. Prompt and uninterrupted union are the great desiderata of success, therefore irritating sutures, oozing, and granulating surfaces should be eschewed. Hæmorrhage from faulty tying of the omentum has been known to cause death, hence the omental stump should be tied in small sections (Figs. 1107 and 1108) and not returned until after the arrest of oozing is assured. Injury of the spermatic and epigastric arteries may give rise to severe and even fatal hæmorrhage. Ligature of the omentum may be followed by perforation of the bowel if tied too close to that organ. Suppuration of the omental stump

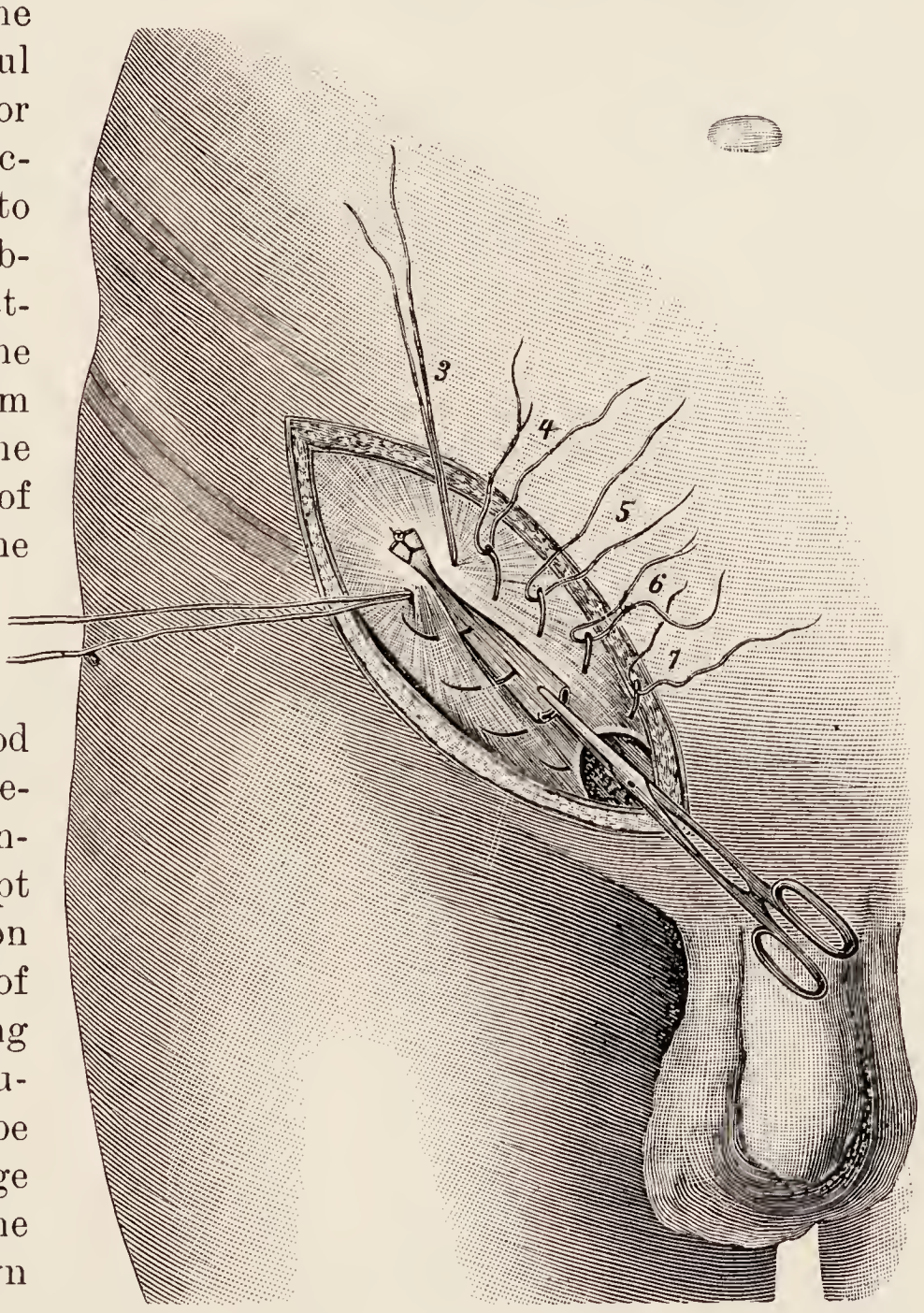



FIG. 1148.—Operation for the radical cure of inguinal hernia, Kocher's method. Sac drawn downward on aponeurosis and sewed in place.

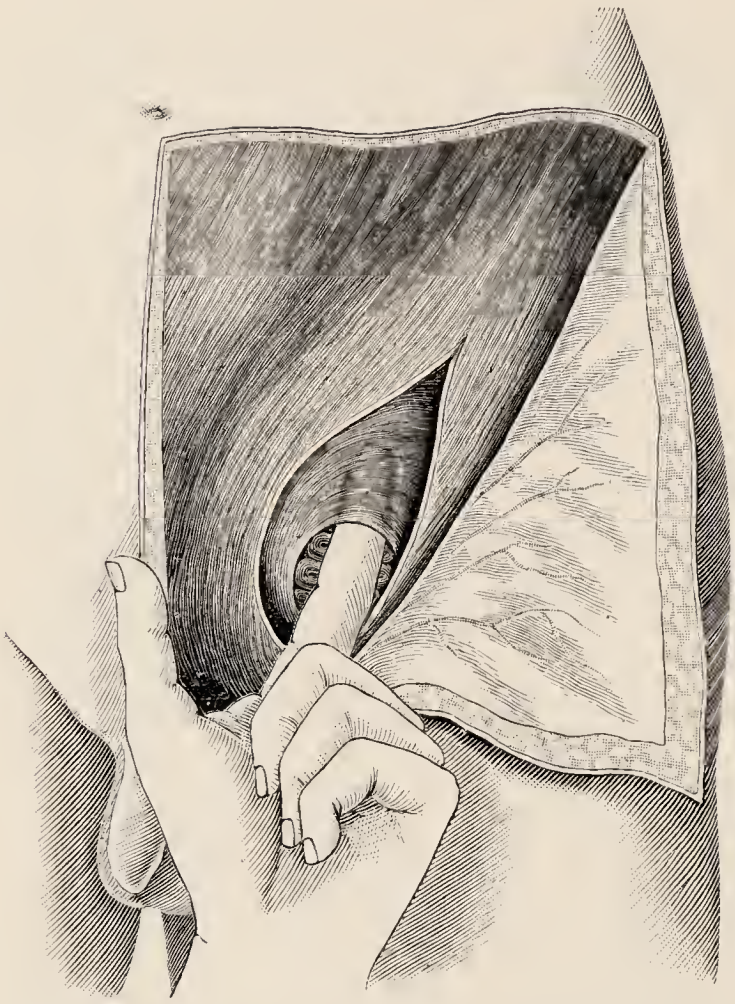


FIG. 1149.—Operation for the cure of inguinal hernia, Macewen's method. Separating the sac from the cord and walls of the canal; folded sac lying behind the finger.

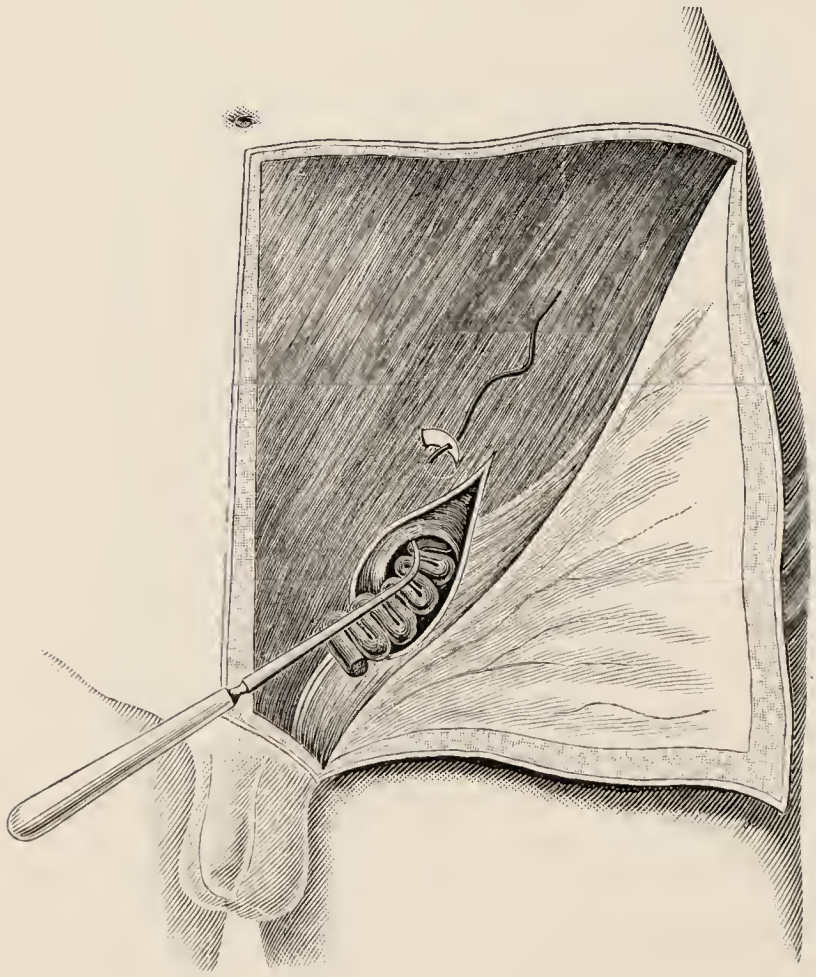


FIG. 1151.—Operation for the radical cure of inguinal hernia, Macewen's method. Carrying the suture of the sac from behind forward through the abdominal muscles, at a point about an inch above the internal ring.

and injury of the bladder when in the sac (Curtis and Gibson) are among the complicating features of the operation. In the female the

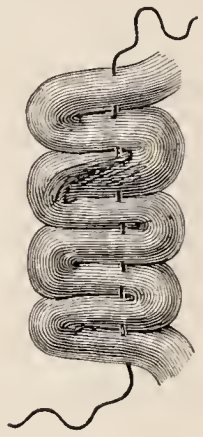


FIG. 1150.—Operation for the radical cure of inguinal hernia, Macewen's method. The pad formed by transfixion of the sac.

round ligament should be carefully avoided.

*The General Remarks.* — Non-absorbable sutures are regarded by Bull and Coley, who have had a large experience and an unusual opportunity of observing the results of the work of others, as inferior to the absorbable. Silk, silkworm gut, and silver wire especially belong to the former class, chromicized catgut and chromicized kangaroo tendon to the latter. With this discrimination we are disposed to agree. The fact that delayed and faulty union adds ten to twenty per cent to the list of failures should lead the operator to faithfully eliminate their causes.

The writer finds much advantage is gained by opening the sac early in the course of dissection near to the upper end, sufficiently to admit the index finger, which serves admirably as a guide and support during the complete separation.

*The After-treatment.*—A strip of iodoform gauze placed upon closed borders of the wound surmounted with dry aseptic gauze

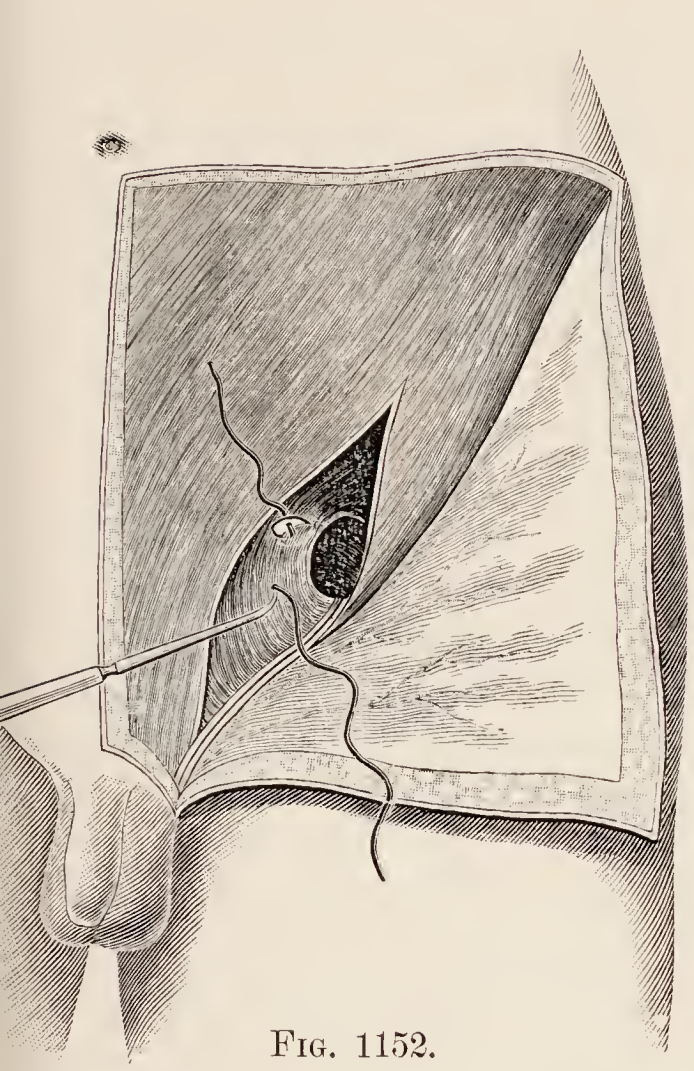


Fig. 1152.

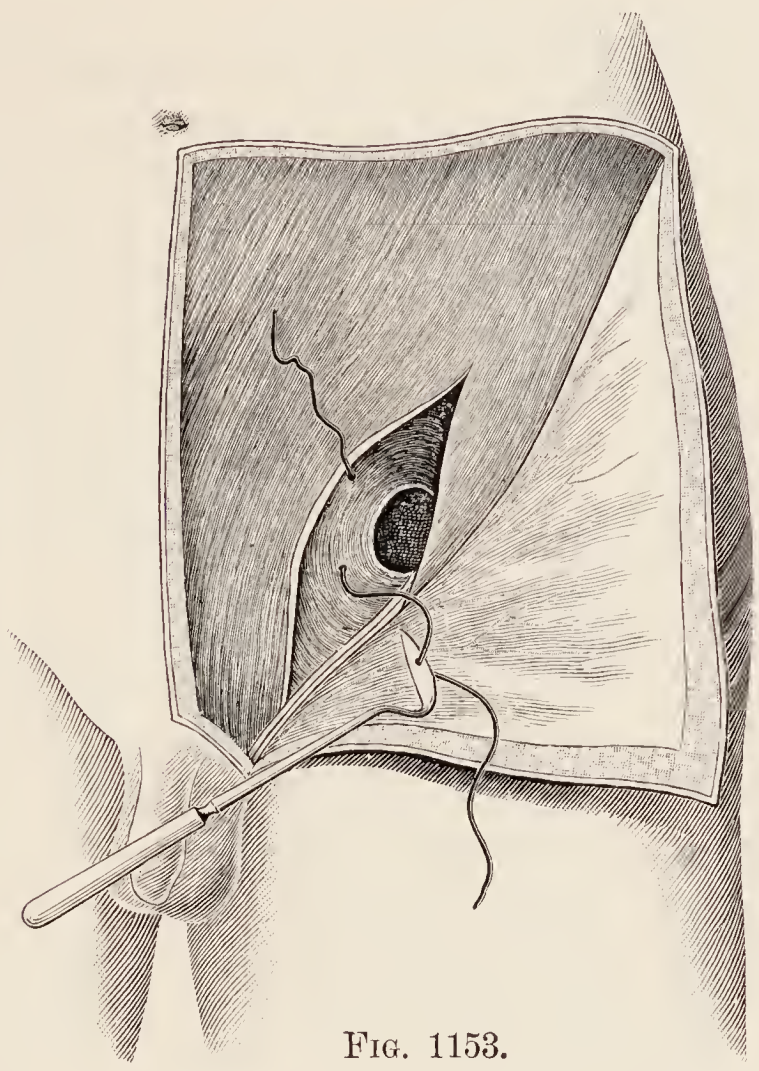


Fig. 1153.

Fig. 1152.—Operation for the radical cure of inguinal hernia, Macewen's operation. Needle passing through conjoined tendon.

Fig. 1153.—Operation for the radical cure of inguinal hernia, Macewen's operation. Ligature carried through the conjoined tendon in two places.

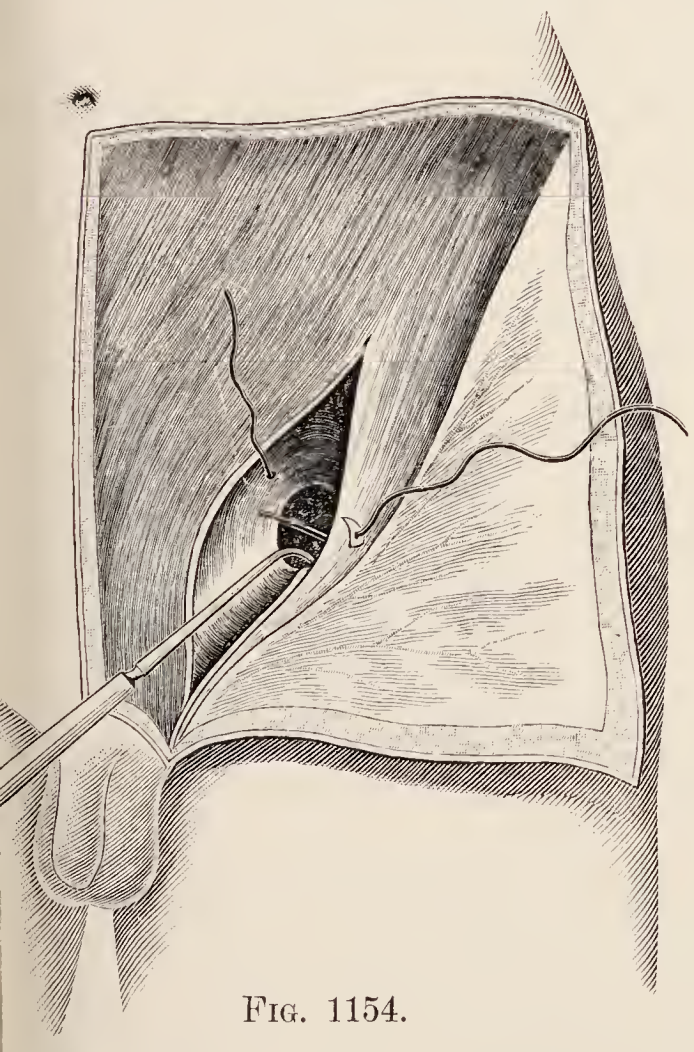


Fig. 1154.

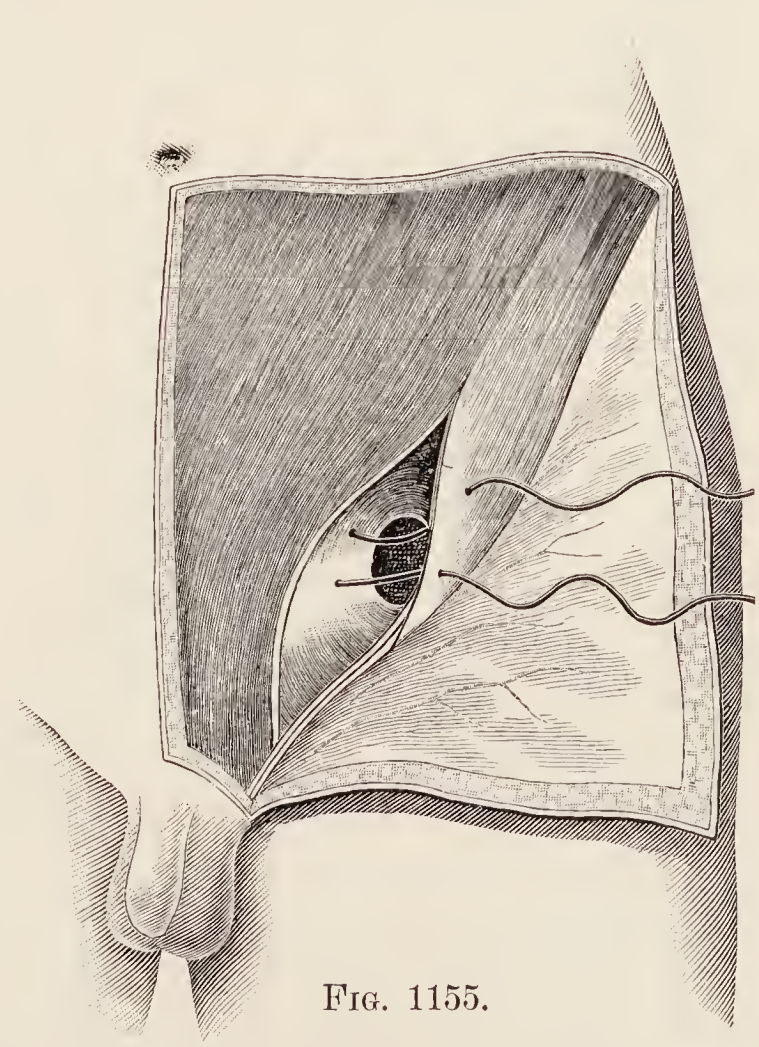


Fig. 1155.

Fig. 1154.—Operation for the radical cure of inguinal hernia, Macewen's operation. The lower extremity of the ligature being carried through Poupart's ligament.

Fig. 1155.—Operation for the radical cure of inguinal hernia. The upper extremity of the ligature passed through Poupart's ligament and the ends ready for tying.

firmly tied in place with a spica meets the usual demands of the dressing. In the instance of children a plaster-of-Paris spica aids in securing quiet and uniform pressure. If the inner aspect of the splints be painted with a solution of shellac the discharges will not soil the dressing. Rubber tissue may be used instead. The patient is kept in bed for two or three weeks after operation, or until firm union has taken place. The abdominal support of the dressings is quite sufficient for this period of treatment. After recovery artificial support by means of a bandage or truss is rarely practiced except in those cases presenting special indications for their use. The avoidance of severe physical effort for some months, however, is strongly urged.

*The Results.*—Operations in childhood and youth are followed by the best results. Patients under four and above fifty years of age should be approached with care in this respect, and only in the presence of special demands for the operation. In selected cases and with skilled operators the death rate is scarcely above one per cent. In children it is even less than this. The final outcome is difficult to establish, since many of the cases are lost to the observation of the operator. However, from 60 to 90 per cent remain cured for a number of years—ten and more. Relapses in 64.5 per cent of the cases occur within six months after the operation; 80 per cent during the first year and 20 per cent after that time. In 71 per cent of the relapses the patients were above thirty years of age and under thirty in 29 per cent (Coley). *Coley* collected 10,500 cases operated upon since 1890 with a general death rate of 0.9 of 1 per cent. Bassini's method is performed more often now than any other. As a rule, a relapsing hernia in this method is more easily controlled than was its antecedent, except in the instance of the repair by granulation.

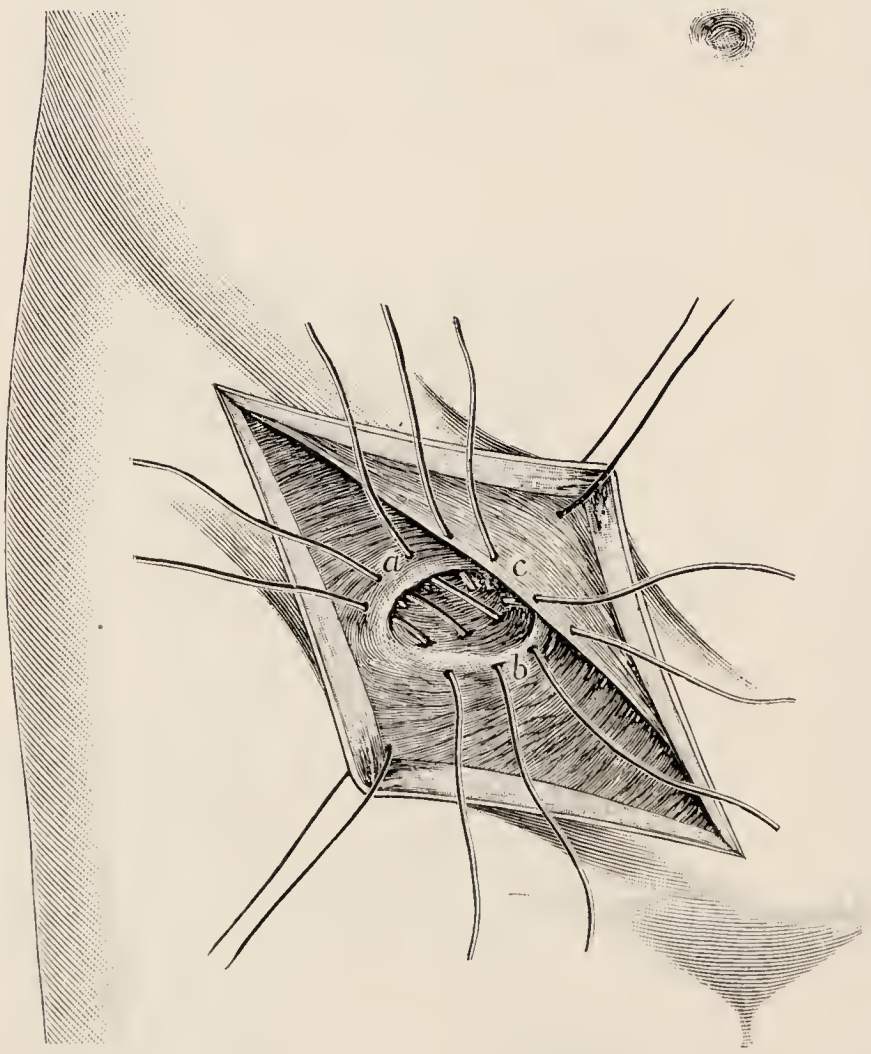



FIG. 1156.—Operation for the radical cure of femoral hernia, Bassini's method. *a*. Falciform process. *b*. Pubic portion of fascia lata. *c*. Poupart's ligament.

**Femoral Hernia.**—*Bassini's Method for Radical Cure.*—Make an incision over the tumor parallel with and half an inch below Poupart's ligament down upon the sac; isolate the sac from the surrounding tissues and from the femoral canal (Fig. 1156) as high up as possible; examine and reduce the contents of the sac and draw it forcibly downward; transfix the neck of the sac, and tie it in halves with a strong silk ligature; cut off the sac close to the ligature and permit the

stump to disappear upward to the abdominal cavity; unite Poupart's ligament and the falciform process, at the outer side with the pectineal fascia and at the inner with the pubic portion of the fascia lata, with five or six silk sutures carried through the respective borders of these tissues and tied (Fig. 1156). The cutaneous incision is closed in the usual manner without drainage.

*The Comments.*—The upper first three stitches unite Poupart's ligament with the pectineal fascia; the second three the pubic portion of the fascia lata with the falciform process of the iliac portion, thus closing the lower end of the femoral canal by apposition of its anterior and posterior borders.

*Coley* closes the canal by means of the purse-string suture (Fig. 1157) passed in the following manner: Carry by means of a curved needle a ligature of kangaroo tendon around and close to the wall of the canal, passing through the inner and upper part of Poupart's ligament, the pectineal fascia and superficial fibers of the pectineus muscle behind the canal, the fascia lata overlying the vessels, and finally through Poupart's ligament about a quarter of an inch from the point of beginning. The sac should be completely freed and the stump allowed to recede far upward before the ligature is tied. Carefully avoid the femoral vein.

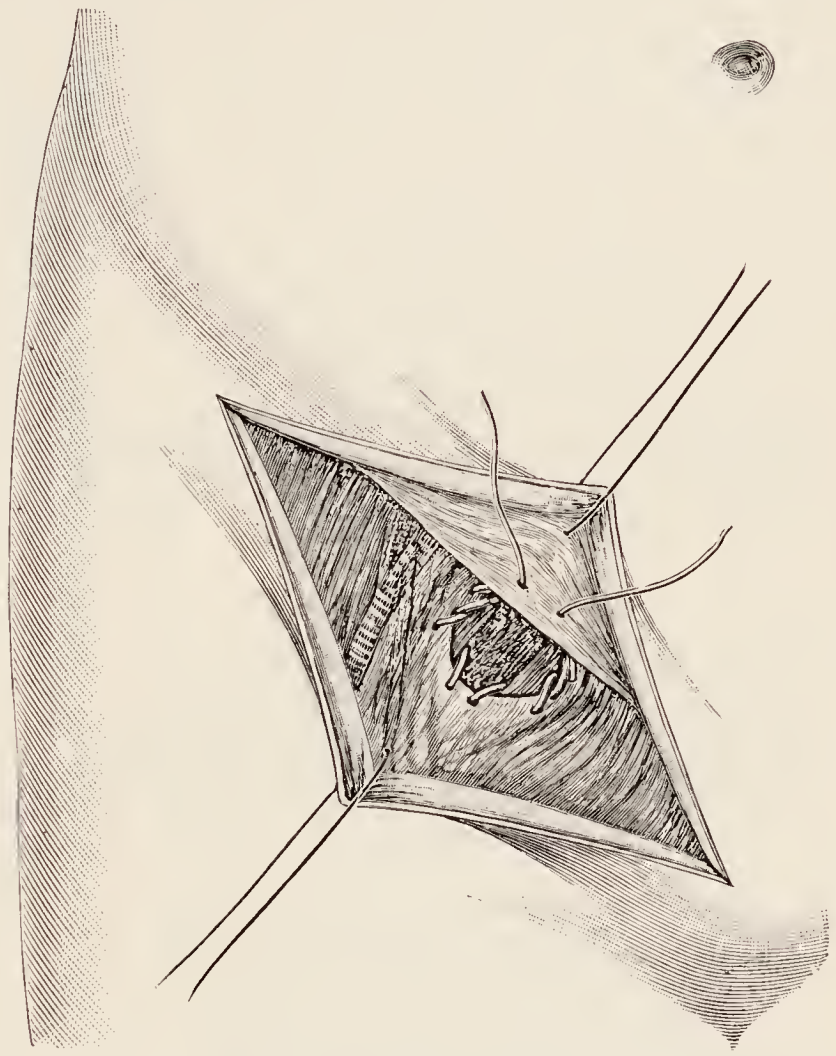


Fig. 1157.—Operation for the radical cure of femoral hernia. Purse-string suture, Coley's method.

*The Results.*—Bassini reports 54 cases with no mortality, of which 41 remained cured from one to nine years. Coley reports 28 cases treated by the purse-string method, with no ascertained relapse, 10 of which were traced from two to seven years. Coley advises Bassini's method of closure if the femoral ring be very large.

**Kocher's Method** (*Femoral Hernia, Radical Cure*).—Make an incision along the inner third of Poupart's ligament down to the sac; isolate the sac up to the crural ring; expose, isolate, and reduce the contents of the sac; make a small opening from above Poupart's ligament through the outer pillar of the external abdominal ring; introduce a forceps through the opening, seize the fundus of the sac and draw it firmly upward through the slit in the pillar; unite the sac to the crural ring by silk sutures passed deeply through Poupart's ligament, the deep crural arch, the sac and the pectineal fascia; cut off the sac close to the sutures; close the external wound and dress in the usual manner.

*The Comments.*—Avoid puncture of the femoral vein in sewing, to obviate both hæmorrhage and thrombosis. *Gordon* closed the canal in an ingenious and effective manner by two sutures so placed as to supplement the closure by interposition of the lower fibers of the internal oblique and transversalis muscles. *Bottini* united the margins of the crural canal to Gimbernat's ligament; *Lowenstein* united the falciform process to the same ligament. The periosteal flap closures of Trendelenburg and others are ingenious conceptions, but are hardly warranted in the presence of the simpler and efficient methods of Bassini, Coley, and others.

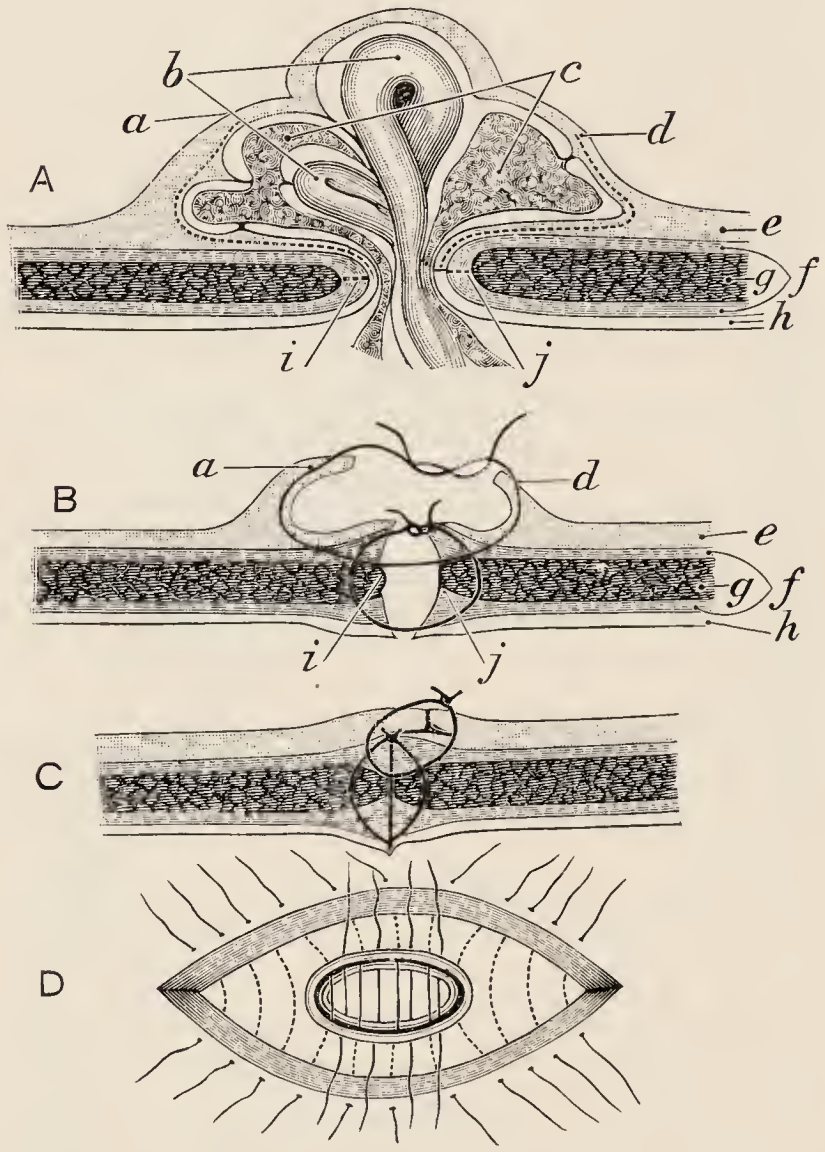



FIG. 1158.—Operation for the radical cure of umbilical hernia, Greig Smith's method. A. Transverse section through hernia. *a, d.* Superfluous skin and sac, the former removed on the outer, the latter on the inner aspect of the tumor. *b.* Intestine. *c.* Omentum. *e.* Integument. *f.* Superficial and deep fasciæ. *g.* Muscles. *h.* Peritonæum. *i, j.* Incisions upon recti muscles made through fascia surrounding ring. Dotted lines between *a, i* and *d, j* indicate the course of separation of the sac. B. Superfluous tissue removed, bowel returned, omentum and sac taken away, and sutures *a, d* inserted. *i, j.* Structures around the ring opened and sutures applied. Other references same as in A. C. Suturing completed. D. Bird's-eye view of wound, sutures inserted for tying.

**Umbilical Hernia** (*Radical Cure*).—Two methods of procedure are commended for the radical cure of umbilical hernia: 1, the reduction of the contents and the freshening and suture with each other of the respective tissues, as in closure of abdominal wounds and the treatment of ventral hernia; 2, the transposition of tissue with the object of strengthening the median line. *In the first method* (*Greig Smith*) under strict asepsis open the cutaneous coverings from top to bottom (Fig. 1158); make a small incision at the thinnest part into the sac, cautiously shunning the bowel (*b*); divide the sac with scissors, guided by the fingers, carefully avoiding the omentum (*c*); return the bowel into the cavity, overcoming the opposing adhesions by separation, ligation, or cutting, as seems best; introduce an anchored sponge or wiper (Fig. 66) into the umbilical opening to prevent the entrance of blood to the abdomen during the dissection; ligature and divide the omentum where it passes through the umbilicus (*i, j*), and return the stump to the abdomen; remove the herniated omentum along with the sac, without separating the adhesions; remove the superfluous integuments and sac down to the circumfer-

ence of the opening; strip the peritonæum from around the umbilical opening (*i*, *j*) and push it into the abdomen; liberate the adjacent borders of the recti muscles by free separation of the margins of the ring; insert deep sutures through the structures down to the peritonæum as indicated (*a*, *d* and *i*, *j*, B and C); remove the wipers from the abdomen, tie the sutures firmly, and cut short the ends; introduce between the intervals of the preceding sutures the superficial ones (*a*, *b*), and tie as indicated in C. The wound is then dressed in the usual manner.

In *Boeckel's method* the sac is isolated and the umbilicus excised through an elliptical incision of sufficient dimensions to meet the demands of the case; the sac is opened, intestine restored, and omentum returned or removed as seems essential to success; the borders of the base of the sac are joined with chain sutures, the sac is resected, and the stump turned inward; the fibrous borders are freshened even to the muscular structures of the recti, if need be. The peritoneal, fascial, fibro-muscular, and cutaneous tissues are united in turn from below upward with silver, kangaroo-tendon, or chromicized-catgut sutures, the last series being of silkworm gut.

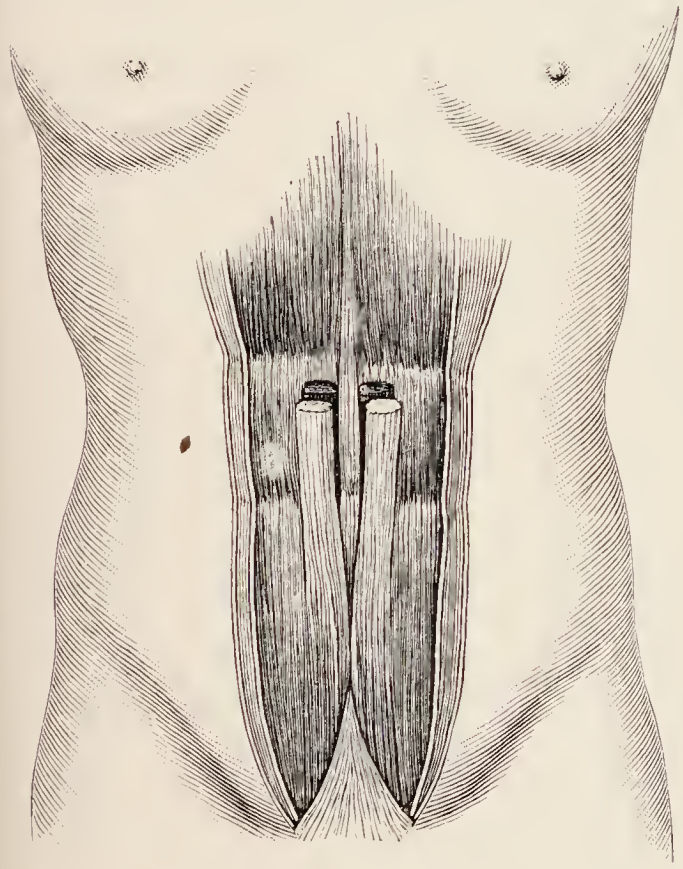


FIG. 1159.

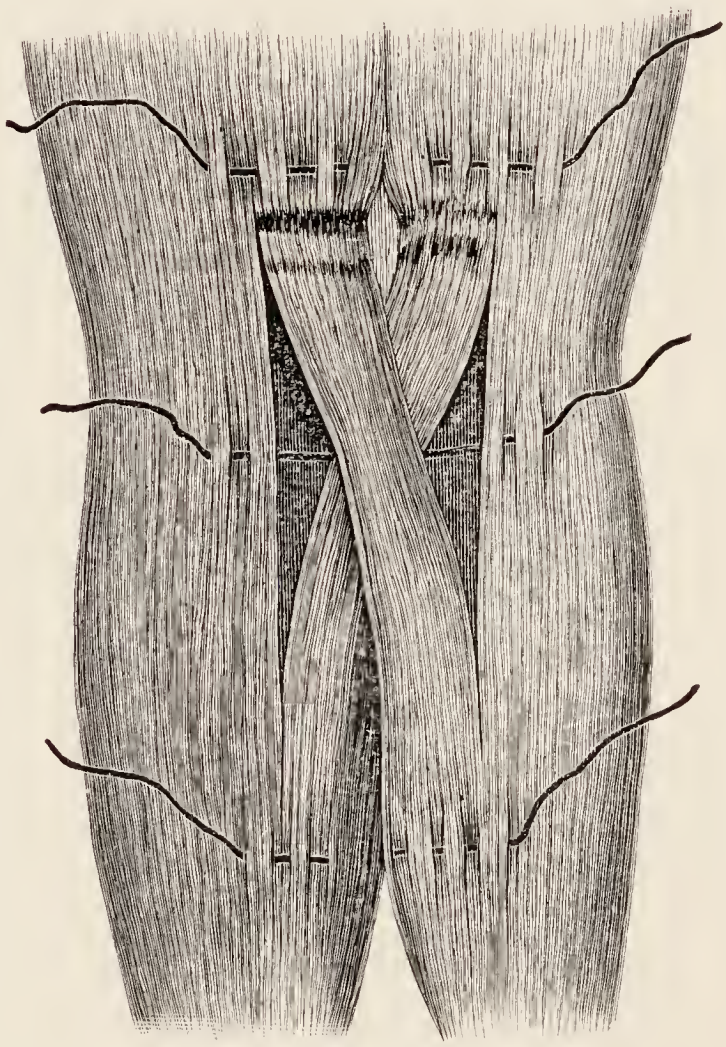


FIG. 1160.

FIG. 1159.—Operation for the radical cure of umbilical hernia, Dauriac's method. Muscular segments prepared for transference.

FIG. 1160.—Operation for the radical cure of umbilical hernia, Dauriac's method. Muscular segments transferred and united, and sutures laid for closure.

*The method of transference* (Dauriac) is practiced as follows: Expose the abdominal recti muscles through an incision in the median line; divide each muscle into two portions by a downward *longitudinal* incision placed nearer to the inner than to the outer borders of the muscles; divide the inner portions with the corresponding part of the sheath transversely at the upper ends (Fig. 1159); transfer the ends and unite them with the opposite

divided extremities above (Figs. 1160 and 1161) and close the remaining gaps as indicated in the cut; unite the borders of the wound as usual, and apply to it a firm compress. *Quénu* advises the following method of practice: *Freshen* and unite respectively the fascia and peritonæum, the posterior lips of the sheaths of the recti, the recti themselves, the anterior lips of the sheaths of the recti, and finally the remaining soft parts with each other. Various other methods of flap formation are advised.

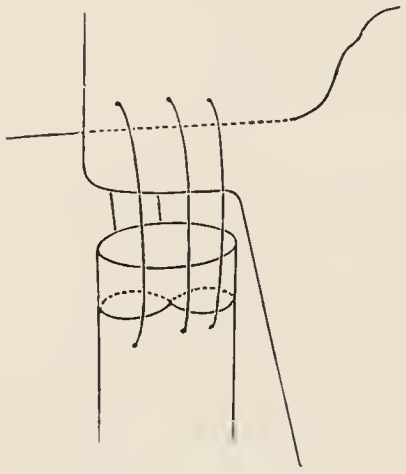


Fig. 1161.—Operation for the radical cure of umbilical hernia, Dauriac's method. Manner of uniting transferred muscular segments, left side.

*The Remarks.*—The omentum is often adherent to the sac at various places, requiring that the direction of the incision be changed and made irregular; this is of no account. Transfixion and ligature of the pedicle with interlocking silk sutures should be practiced to render the vessels secure. Free liberation and firm apposition of the contiguous borders of the recti is an important element of the technique. In some cases a single row of sutures may be sufficient to properly close the opening; a double one is better. *Phelps's* wire-filigree support may be introduced in umbilical and ventral herniæ, especially if largely and insecurely provided against return, by the normal tissues. A hernia elsewhere similarly conditioned may be thus treated. The anatomy of the infantile and of the congenital forms should be noted.

*The Results.*—The results from the independent union of freshened borders of selected tissues are excellent. In 300 cases 265 cures and 35 deaths are reported, a mortality rate of nearly 12 per cent (Boeckel). Of these, 105 were strangulated and 195 non-strangulated, with a death rate of 30.5 and 1.95 per cent respectively. Relapse occurs more frequently in these than in radical cure of inguinal hernia. The results of the experience of Bull and Coley and of the writer are not so favorable as the preceding appear to be, and the differences in the operative technique are hardly sufficient to account for those of the operative results. Sufficient data are not at hand to enable one to judge wisely of the utility of cure by the transposition of tissue.

**Ventral Hernia** (*Radical Cure*).—Ventral hernia usually occurs in the median line, and is a common sequel of median cœliotomy. It also happens at other situations of the abdomen from operative practice. *Greig Smith* advised the separation of the areolar tissue between the skin and peritonæum (Fig. 1162) by means of the finger or curved scissors inserted through a small opening made along the main direction of the hernia. The superfluous skin is removed, the peritoneal sac turned inward, and if abundant united with a continuous suture carried through the areolar tissue. If of less amount it may be included by the suture closing the parietal incision. Healthy muscular structure is freely exposed by dissection, and the borders are united by suture *en masse* as noted in Fig. 1162.

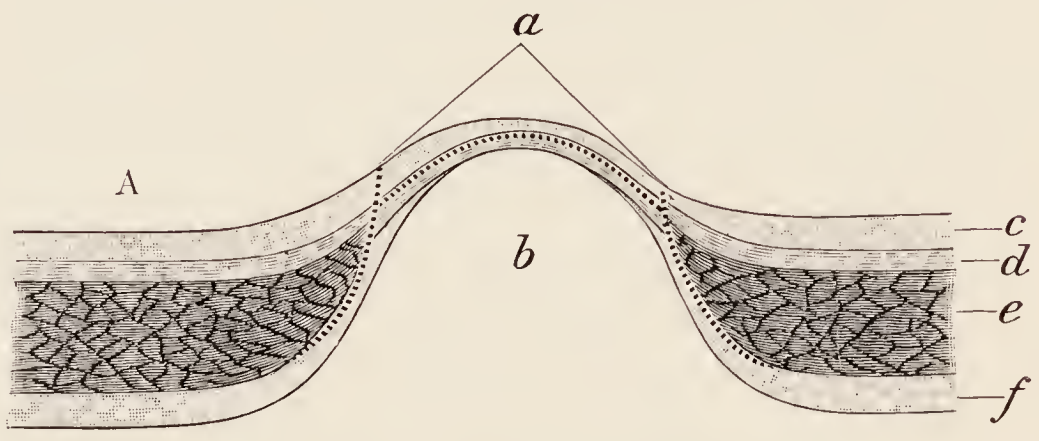
*The Remarks.*—The abdomen is not opened in this procedure; broad muscular surfaces are apposed and the inturned sac contributes a fenderlike

opposition to intestinal pressure. Muscular tissue should be brought in contact at the line of union even if the detachment of separate bundles be required for the purpose, to insure firmer union.

*Hernia following Appendicitis.*—This infliction frequently follows free incisions in suppurating cases of appendicitis. In the earlier history of operative practice it happened in ten to fifteen per cent of the instances. In curing the infliction *Coley* advises free excision of all the cicatricial tissue, careful dissection and exposure of the internal and external oblique muscular planes, with separate suture of each with kangaroo tendon.

*The Results.*—The results of operation for radical cure of ventral hernia are much less favorable and the fatality is greater than in similar procedures for the inguinal and femoral kinds. Up to 1898 *Bull* and *Coley* had operated for radical cure in 19 umbilical and 15 ventral herniæ. Of the latter, 11 followed laparotomy and 4 open-wound treatment of suppurative appendicitis.

*Lateral ventral hernia* is rare, and makes its appearance at Petit's triangle. Of 29 cases collected by Braun, 20 were congenital, or developed spontaneously, and 9 had a history of traumatism. This form has not yet been investigated sufficiently to enable one to lay a special method of practice for cure on relief of strangulation. The general indications of treatment in the other forms have equal force in this.



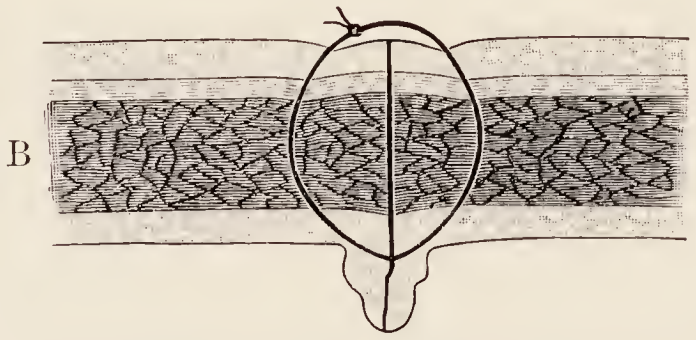




FIG. 1162.—Operation for the radical cure of ventral hernia, Greig Smith's method. A. Transverse section of ventral hernia. *a*. Stem between dotted lines to be removed. *b*. Hernial pouch. *c*. Integument. *d*. Fascia. *e*. Muscles. *f*. Fascia and peritonæum. Lines of incision indicated by dotted lines. B. Redundant stem removed, peritonæum turned in, and wound closed.

**Cæcal Hernia.**—The presence of the entire or a portion of the cæcum in a hernial sac happens in about four per cent of the cases of hernia in the inguinal region. Rarely indeed it is that the cæcum is not partly or wholly covered with peritonæum. Cæcal hernia happens four times oftener at the right than the left inguinal region, and is five times more frequent at the right than the left femoral region. The presence in the sac of the cæcum is rarely known until the contents are exposed by incision. If covered with peritonæum, the cæcum is readily reduced; but, if partially or entirely uncovered, the return is often difficult, owing to the contact of non-serous surfaces; still, patient and careful manipulations will secure a return of the viscus, after which the operative technique is similar to that of the simpler forms of hernia.

**Hernia of the Bladder.**—Hernia of the bladder is not infrequent, and is chiefly dangerous because of the liability of cutting into it before recognition. Gibson reports 103 cases in which the bladder was wounded in 67, and uninjured in 36. The bladder may be intraperitoneal or extraperitoneal, sometimes both. It is mistaken for the primary or a secondary hernial sac; for cystic tumor and fatty accumulations. When its presence is suspected, the employment of a hypodermic needle or the introduction of a sound to the bladder should promptly settle the matter. The return of the viscus to the abdomen is not especially difficult. The wound of the bladder is closed and the patient treated in other respects as is usual in such wounds (page 1200).

*The Results.*—The rate of mortality is about twelve and a half per cent (Gibson).

**Local Anæsthesia in Operations on Hernia.**—The employment of local anæsthesia in the relief of strangulated hernia and for radical cure, especially when old age and organic infirmity forbid the use of general anæsthesia, has been brought prominently into view by *Cushing*, of Baltimore. Operations, relating to the abdominal contents, of even greater significance than hernia have been satisfactorily practiced with local anæsthesia. *Infiltration anæsthesia* with the second solution of Schleich (page 31) has proved satisfactory. The basis of the utility of the plan rests on the fact that the cocainization of the trunks of sensation nerves renders anæsthetic the field of their supply. The location of the primary incision and of subsequent dissection to the nerve trunks and their areas of supply, though well demonstrated by the illustration (Fig. 1163), should be carefully studied before operation to determine their comparative relations with each other. The importance of the detail of the procedure is so pronounced that we beg to quote in full the description of Cushing:

"*Steps of the Operation.*—Individuals advanced in years are usually kept in bed for a day or two preliminary to the operation, to give an indication of their ability to endure recumbency, and for the purpose of training them to void their urine in this position. Evacuation of the bladder is usually accomplished by the aid of an enema if any postural difficulty is experienced.

"It has been the custom to administer hypodermically a tenth or an eighth of a grain of morphin three quarters of an hour before, and to repeat this shortly before the operation. *Ceci* has emphasized the efficiency of this morphin-cocain combination, and I have found it most satisfactory. The drug must be used with caution, however, since occasionally even small doses of morphin in old people may confine the bowels and lead to distention, which may be troublesome. Similarly, in old people with tardy bladders, it may inhibit the proper evacuation of the urine, though we have never had the misfortune to observe this.

"Patients past middle age also are usually shaved and prepared on the operating table to avoid any exposure incidental to an open ward preparation. The skin in the line of proposed incision is infiltrated with Schleich's cocain solution, and the incision may be immediately made through the linear wheal thus produced. It is common experience to find the infil-

trated tissues more vascular than usual, and it is important that all bleeding points be immediately clamped, since a dry and unstained field is essential to the success of the dissection. It is unnecessary and useless to attempt to anæsthetize the panniculus. As Schleich has shown, only tissues which

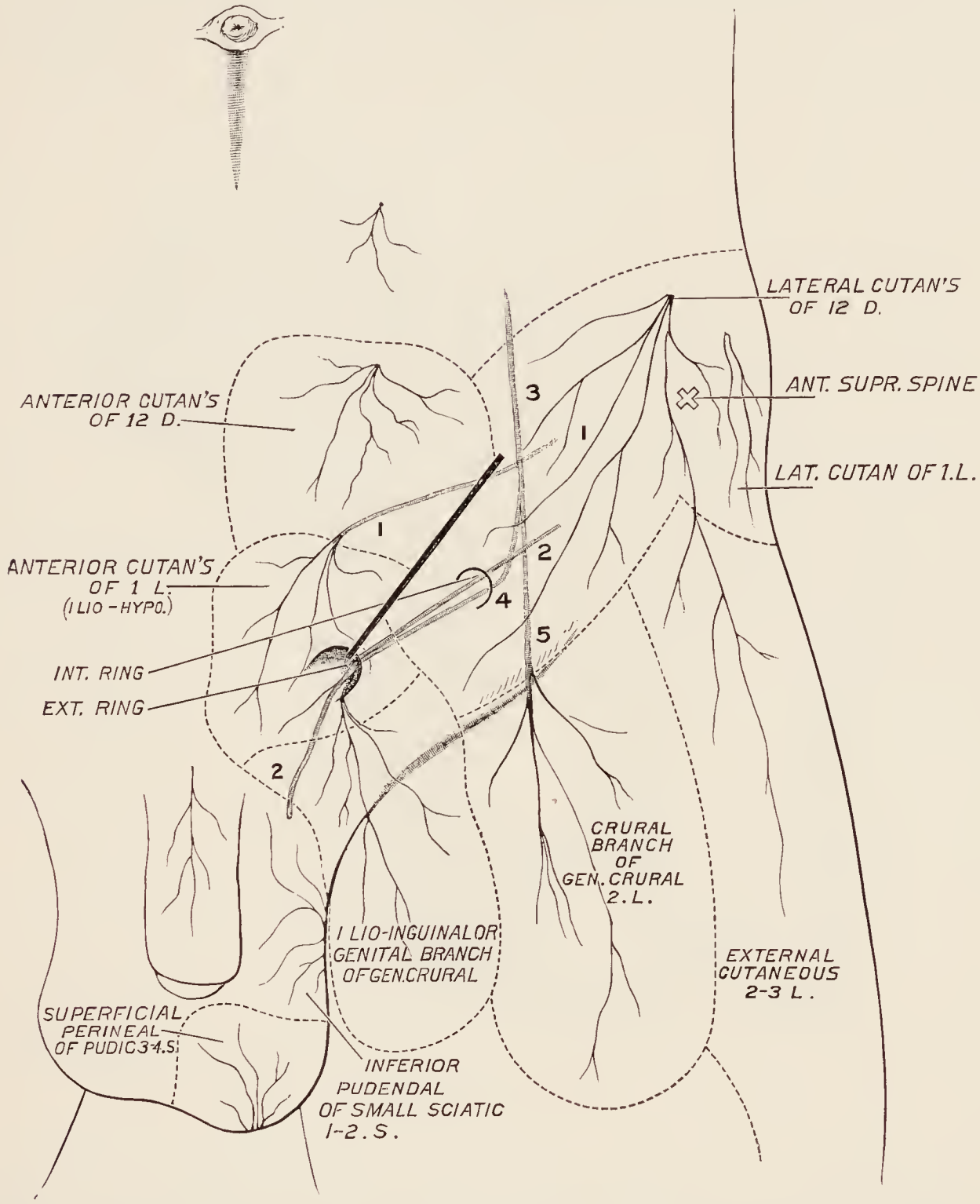



FIG. 1163.—Operation for the radical cure of inguinal hernia under local anæsthesia, Cushing's method. The peripheral distribution, and the relation of the trunks of the inguino-scrutal nerves to the main incision. *1.* Ilio-hypogastric nerve. *2.* Ilio-inguinal nerve. *3.* Genito-crural nerve, its genital (*4*) and crural (*5*) branches.

can be 'œdematized' are fitted for the infiltration method, and in the panniculus, at the upper angle, practically no nerves are encountered. If, however, throughout its whole length, this incision is carried down to the aponeurosis, unanæsthetized fibers of the ilio-hypogastric will be encountered in the superficial fat at the lower angle, together with one or two large veins, division of which is painful, so that anæsthetization of the panniculus layer is here necessary, or else, as has been done on several occasions, the incision only at the upper angle may be carried down to the aponeurosis, which is then opened in the line of fibers from the external ring, and the ilio-hypogastric

and inguinal nerves immediately cocainized with a one-per-cent solution as they lie under it. After this procedure the lower angle of the incision may be painlessly carried down to the external ring, and the remaining intercolumnar fibers of the aponeurotic insertion divided. Reflection of the pillars of the ring gives the view shown in the accompanying sketch (Fig. 1164). In the Halsted operation at this stage the internal oblique fibers are divided, preliminary cocainization of the edge of the muscle being necessary for the

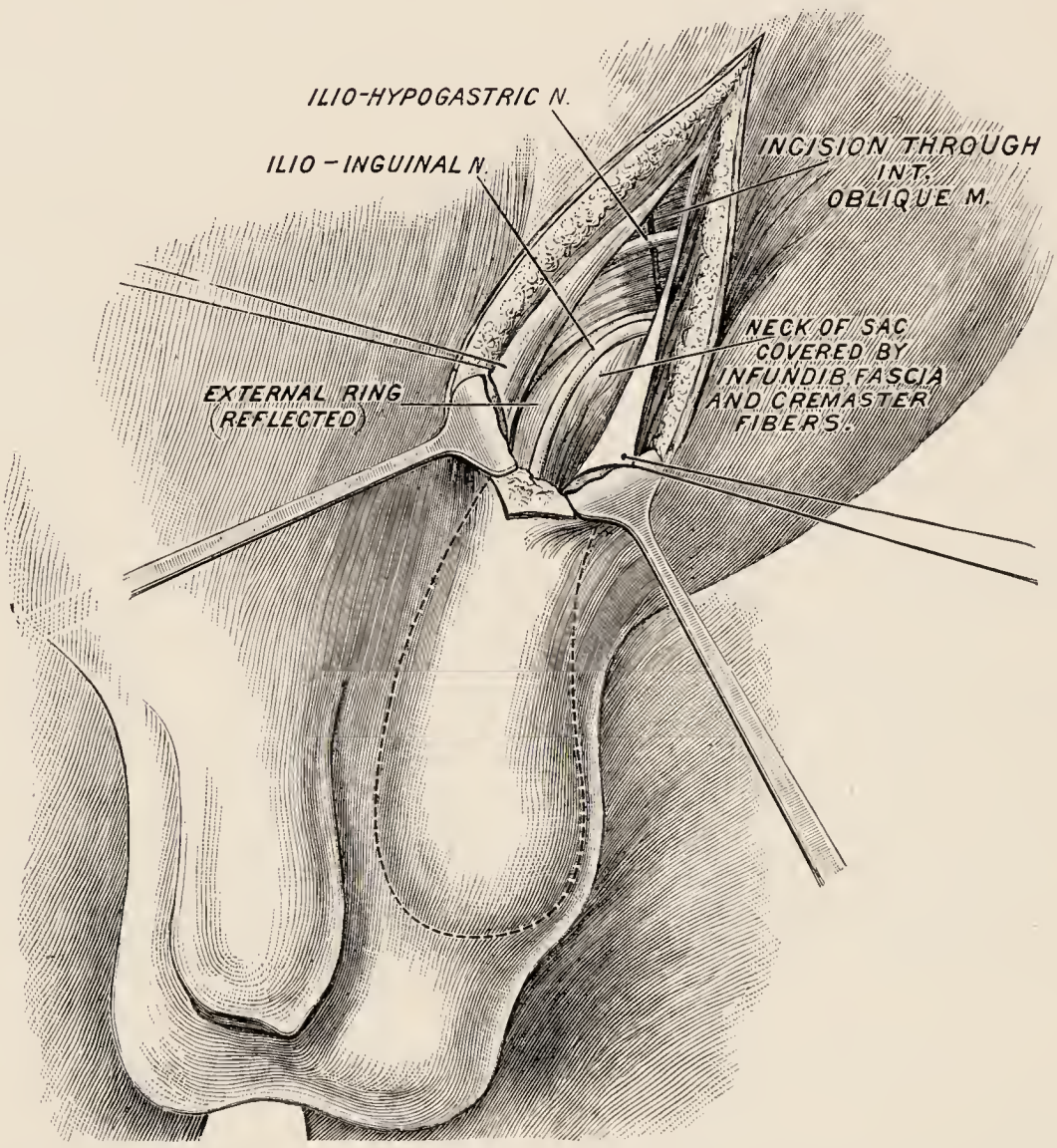



FIG. 1164.—Operation for the radical cure of inguinal hernia under local anæsthesia, Cushing's method.

reasons given above. There is, under ordinary circumstances, no further need of the anæsthetic, as we are working in an area freed from all sensation. The combined ilio-inguinal and genital branch, which has been cocainized at the outer limit of its exposure, is now reflected to one side or the other, care being taken not to divide it, since this leads apparently to a more or less permanent paralysis of the cremaster, which is to be avoided. I believe the accidental division of this nerve leads to the great relaxation of the scrotum so often seen after hernia and varicocele operations. In the latter operation, especially, it would be detrimental to the best interests of a successful result to interfere with the cremasteric function in any way. The remainder of the operation—the exposure of the sac and cord after a longitudinal division of the infundibuliform fascia, the amputation of the sac at its neck and closure of the peritoneal opening, the excision of the fundus of the sac, division of the cord, and castration, if deemed advisable—may now

be done practically without pain. Occasionally, however, some stray fibers of the genito-crural may be encountered about the neck of the sac, and also during castration I have found that ligation of the veins at the lower pole of the testicle may be painful, though division of the cord above is not. Possibly the superficial perineal branches which have been unanæsthetized furnish nerves to this lower blood supply."

*The Remarks.*—Those patients who bear slight pain badly, those in whom the inhibiting influence of the drug is transient or exhausted, and those with strong imaginations, may require the aid of a little morphin, and perhaps now and then a few breaths of chloroform. A careful study should be made of the course and supply of the sensitive nerves involved in the operation before attempting the procedure, to avoid direct injury of them, also to lessen needless infliction of pain. Anæsthesia of individual trunks and their areas of distribution is secured by direct injection into the trunks of a half of one-per-cent solution.

Handling and repair of healthy intestine do not cause especial pain, therefore local anæsthesia is not needed. However, the manipulation of strangulated and diseased intestine causes referred pain, usually to the epigastrium. Sterilization of food and aseptic treatment of the mouth decidedly lessens the putrefactive changes of intestinal torpors and obstruction.

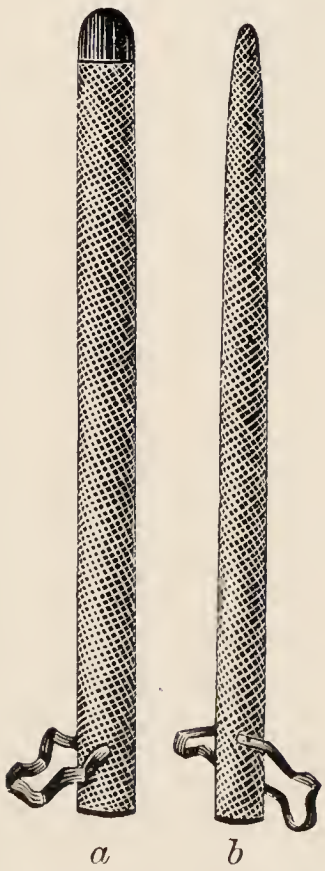
*The Results.*—Twenty-five cases of operation for radical cure are reported; 6 were strangulated, of which 1 died; the remaining 19 recovered. Thirteen of the entire number were above sixty years of age, 7 of which were seventy and over.

## CHAPTER XV.

### *OPERATIONS ON THE ANUS AND RECTUM.*

Since the approach to the rectum and lower intestine is by way of the anus, and as the anus is subject to disease amenable to surgical effort, to it will be given the primary consideration.

**The Examination of the Anus.**—Examination of the anus is a necessary preliminary to diagnosis and operations directed to the lower end of the bowel. The examination can be conducted with the patient placed in any one of the following positions: 1, the knee and elbow position; 2, upon the back, with the thighs drawn upward; 3, upon the right side, with the knees drawn upon the abdomen; 4, with the patient kneeling on the seat of a chair and leaning over its back. Usually the patient is placed on the back in the lithotomy attitude. However, the most comfortable and delicate position is upon the side. It is hardly necessary to add that the surgeon should be familiar with the normal characteristics of the parts, not only those relating to the appearance, but also to their sensibility and pliancy. On inspection, the wrinkled aspect of the anal opening and of the contiguous integument, the condition of the blood-vessels about the opening, and the white line at the muco-cutaneous junction, corresponding to the interval between the internal and external sphincters, should be noticed. The degree of sphincteric contraction, and the irritability of the patient, as evidenced by the introduction of the finger into the anus, are important items relating to cure. Thorough cleansing of the bowel, and the final escape of the fluids employed for this purpose, should be secured before any special attempt is made to examine the anus or rectum.



*a* *b*

Fig. 1165.—Rectal bougies. *a*. Cylindrical. *b*. Conical shaped.

**Imperforate Anus.**—Imperforate anus is characterized by a layer of tissue of variable thickness which exists between the normal site of the external opening and the lower extremity of the rectum. It may be simply a thin layer of fibro-cellular tissue, which, by projection, indicates the nearness of the loaded bowel. In these cases the active emotions of the child may be noted by the movements of the interposed membrane, and a positive diagnosis can be made by a hypodermatic puncture. If the septum be thin, a longitudinal or crucial incision, or even a simple puncture, followed by the

careful introduction of a well-oiled finger, will be a sufficient operative interference, especially if afterward the extremity of a suitable sized rectal bougie be occasionally introduced (Fig. 1165). If the membrane be of sufficient density to interpose an obstacle after its division, it should be trimmed away, care being taken not to include the structure proper of the opening. Severe and even fatal hæmorrhage has been known to follow these apparently trivial operative procedures.

**Absence of the Anus** (Fig. 1166).—In this deformity all trace of the opening is absent, and the median rhaphe may extend continuously from the scrotum to the tip of the coccyx. The fibro-cellular interval may be either thin or of extreme thickness. If thin, the previously detailed signs of imperforate anus may be evident. When, however, they are not present, the occlusion is of considerable thickness, and may even involve the entire length of the rectum itself (Fig. 1167). In the latter instance the sphincter

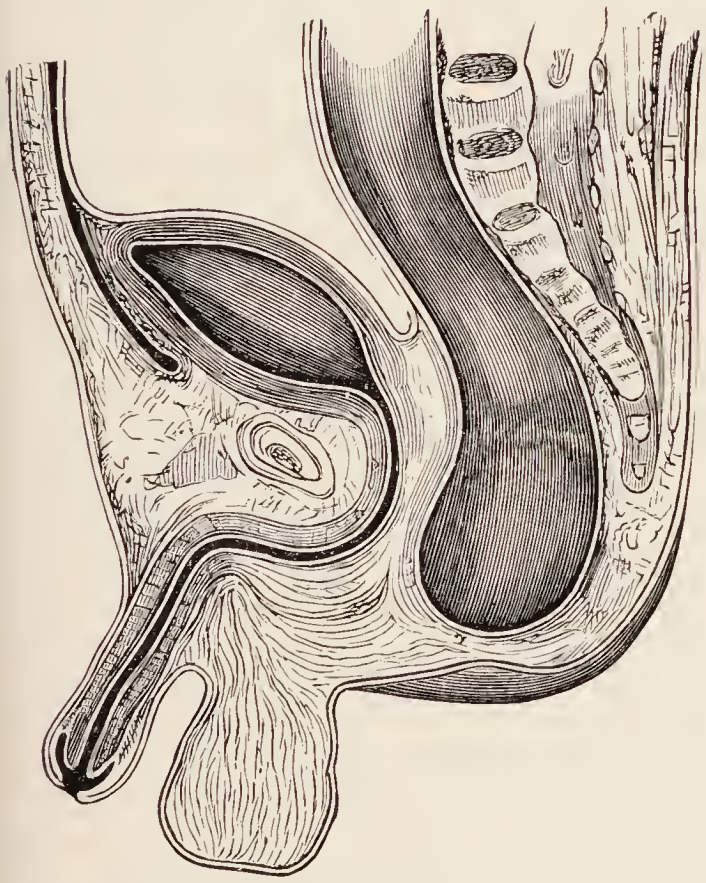


Fig. 1166.—Absence of anus.

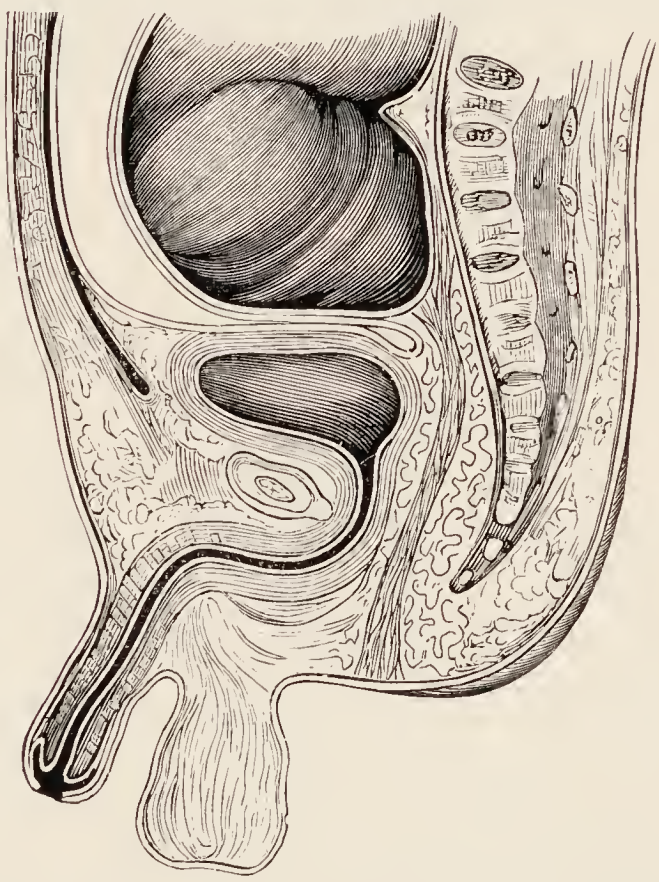


Fig. 1167.—Absence of anus and rectum.

is sometimes wanting. The rectal pouch may hang loosely in the pelvic or abdominal cavity, or be attached to some contiguous structure. A distinct fibrous band may lead from the skin to the rectal pouch, or only cellular tissue may intervene.

*The operation* for relief consists in first placing the patient, properly anæsthetized, in the dorsal position with the pelvis elevated. Then introduce a sound into the bladder if the patient be a male, or into the vagina if a female, and make a vertical incision in the median line from just behind the scrotum or vagina, as the case may be, to the tip of the coccyx (Fig. 1168); deepen it cautiously up and backward, shortening each succeeding cut, and carefully feel for the fluctuating extremity of the gut. The latter is sometimes located posterior to the central line, and must be sought for near the hollow of the sacrum. During the entire progress of the dissection the situation of the vagina or urethra must be marked by the location

of the sound previously introduced. When the dark-brown, fluctuating extremity of the gut is detected, the introduction of a hypodermic needle will settle all doubt. The gut end should then be seized by a strong, toothed forceps (Fig. 1169), and drawn firmly downward, while its connections with the surrounding tissues are separated by the scissors and fingers. As soon as the *cul-de-sac* is drawn down to a level with the external opening, two short ligatures are passed transversely through the sides of the wound (*b*, *e*), or through its anterior and posterior extremities, transfixing in either instance the walls of the bowel in their passage, but not entering the lumen of the gut. Protect the raw surfaces with lint saturated with carbolized oil, then open the sac between the ligatures and allow the contents to escape; after having thoroughly cleansed the parts, remove the lint and unite the border of the sac with the anus by interrupted silkworm-gut sutures (Fig. 1170). Cleanse the bowel thoroughly, and introduce a small, coaptating plug of iodoform gauze perforated by a good-sized rubber tube (Fig. 1171, *e*) to exclude fæcal matter from the line of sewing, and to permit the escape of intestinal gases at the same time. The mucous membrane should be closely adjusted to the integument, in order to secure perfect union and prevent the contact of the raw surfaces with the discharges. If it be impossible to draw the end of the gut down to the external opening, it can be incised at its lower extremity, and the discharges allowed to escape over the lower surfaces, which are kept open by the use of the

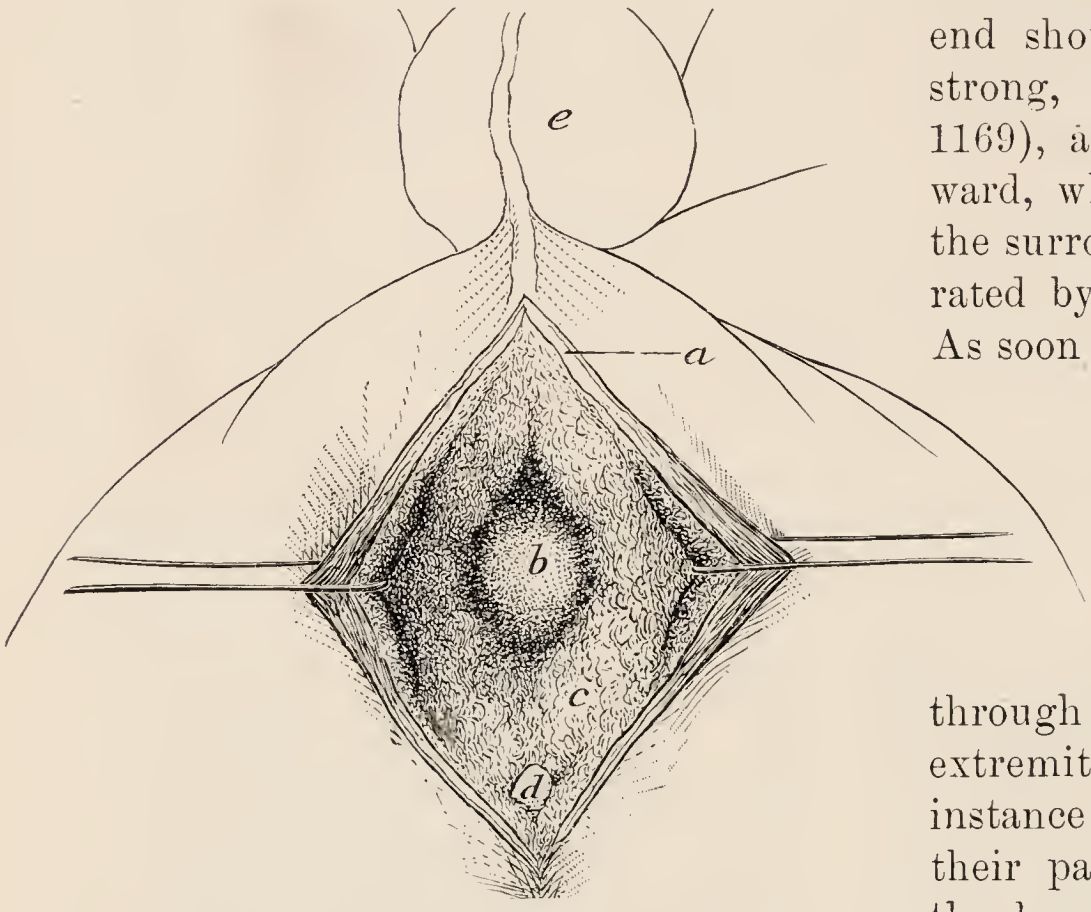



FIG. 1168.—Operation for absence of anus. *a*. Border of cutaneous incision. *b*. End of bowel. *c*. Perirectal tissue. *d*. Extremity of coccyx. *e*. Scrotum.

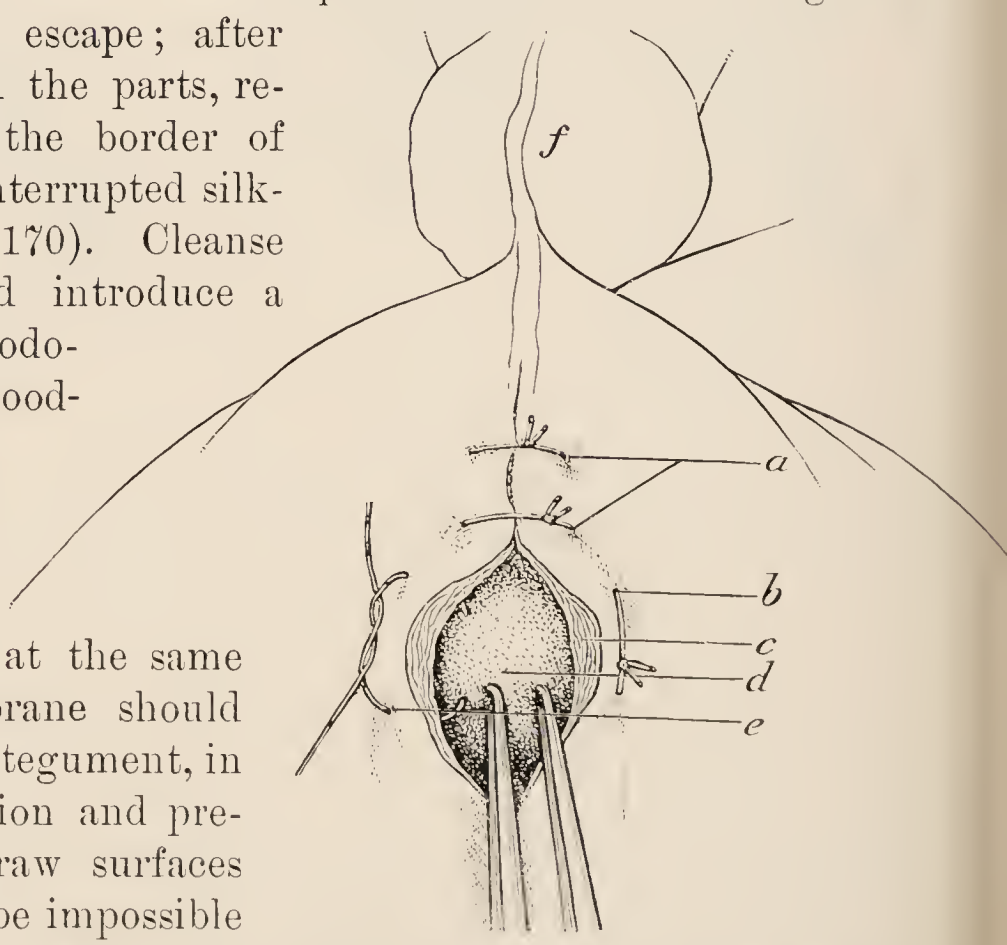



FIG. 1169.—Operation for absence of anus. *a*. Sutures at anterior aspect of wound: the posterior one may pass through the wall of the *cul-de-sac*. *b*, *e*. Sutures at sides of wound, both transfixing the wall of the *cul-de-sac*. *d*. Rectal *cul-de-sac*. *f*. Scrotum.

bougies; or the coccyx can be removed, as recommended by *Verneuil*, and the extremity of the bowel drawn through the gap and united to the integument as before.

*The Remarks.*—The usual distance between the pouch and the perinæum is about two inches, and the site can be well located by the occasional introduction of the hypodermic syringe. Fatal cellulitis may follow the dissection directly or from the efforts to maintain the patency of the new canal (Fig. 1170).

**Fistula in Ano.**—A fistula here, as elsewhere, is a sinus, which in this case leads into the cavity of an abscess located near to the rectum. It may be either complete or incomplete; if of the latter variety, it may be an incomplete internal or external fistula (Fig. 1172). The complete form (*b*) is the more frequent. In either variety the openings are usually situated within an inch or less of the anus. These fistulæ are of devious shapes and of varying extent, the horseshoe variety (page 954) often being very perplexing.

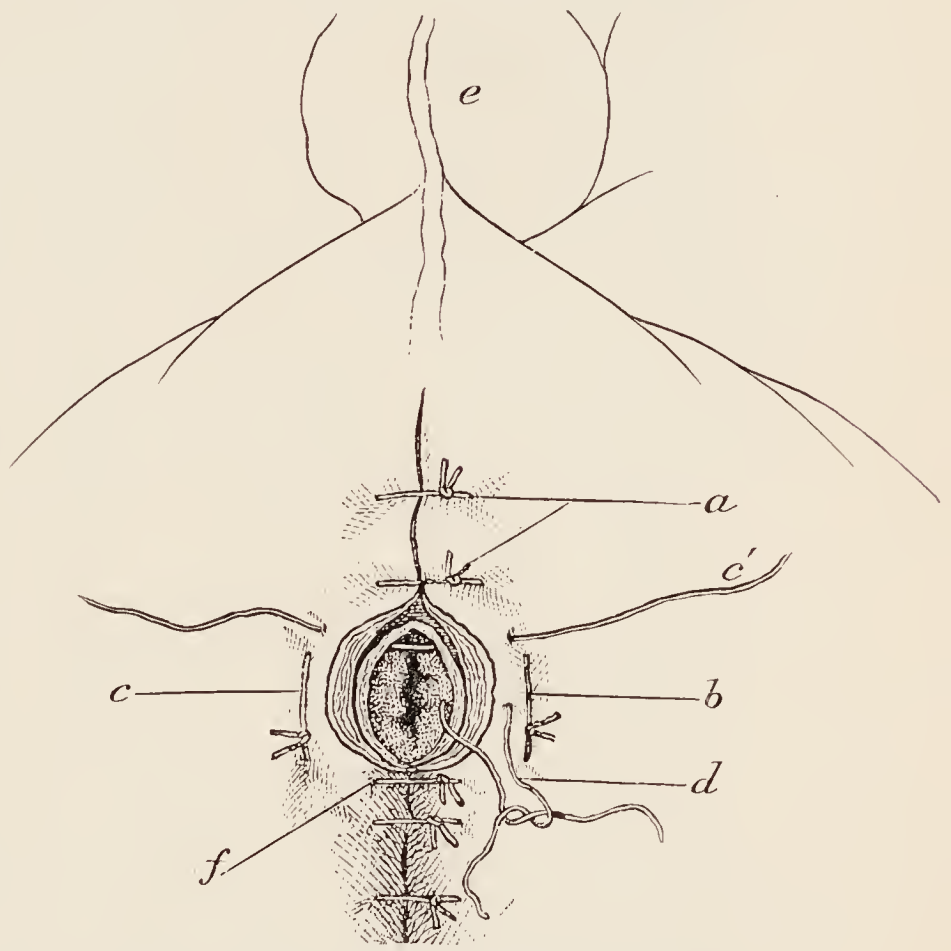



FIG. 1170.—Operation for absence of anus. *a*. Primary anterior sutures. *b*, *c*. Lateral sutures tied. *f*, *c'*. Anterior and posterior sutures transfixing wall of gut. *d*. Example of suture of gut to border of wound.

*The Examination for the Detection of a Fistulous Opening.*—Evacuate the bowel by a cathartic and an enema; place the patient on the back or side, and introduce the well-oiled index finger of the hand corresponding to the side of the patient presenting the external opening into the rectum. The careful movement of the end of the finger over the mucous membrane will often detect a nipple-like projection indicating the internal opening. If a *flexible* probe be introduced through the external opening, it can, with a little care, be carried into the lumen of the rectum. Sometimes, however, the end of the probe will be felt separated from the finger by only the thin mucous lining of the gut; this may be due to the inability to find the internal opening or to its non-existence. In either case the thin wall should be perforated by the instrument, thus producing a complete fistula. It not infrequently happens that more than one opening (*c*, *e*) communicates with the seat of the original abscess, *d* (Fig. 1173), and also that the mucous membrane is undermined to a considerable extent above a previously existing abscess (Fig. 1174, *a*).

*The Remarks.*—It is of importance to remember that the introduction of the finger or the probe often produces such a degree of contraction of

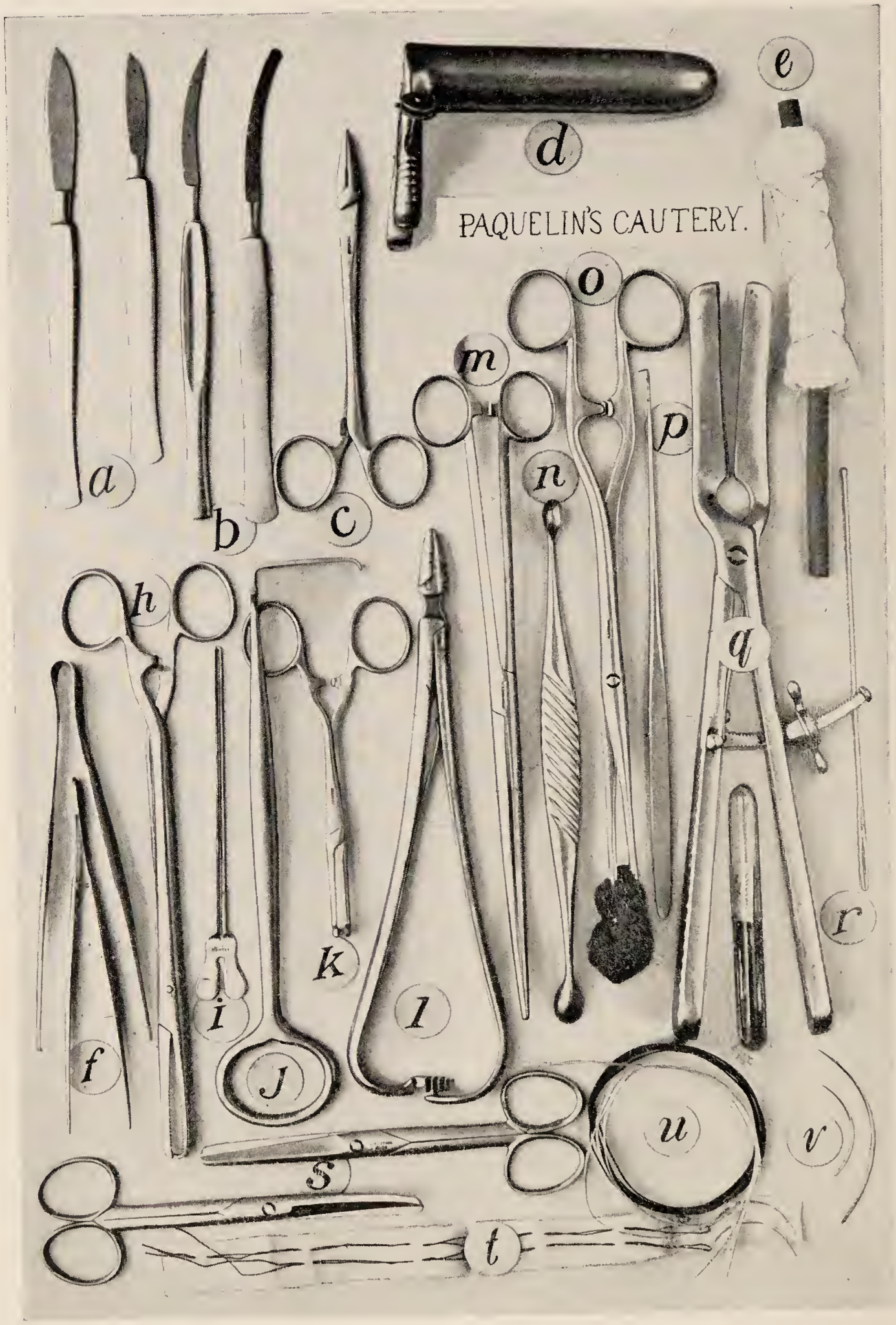



Fig 1171.—Instruments employed in operations on the anus.

*a*. Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Speculum. *e*. Rubber tube mounted with gauze for introduction into the anus and rectum. *f*. Dissecting and mouse-tooth forceps. *h*. Strong hook forceps. *i*. Grooved director. *j*. Blunt retractor. *k*. Pile forceps. *l*. Needle holder. *m*. Long-nosed clamp forceps. *n*. Scoop. *o*. Sponge holder. *p*. Tenaculum. *q*. Pile clamp. *r*. Silver probe. *s*. Curved and straight scissors. *t*. Ligatures armed with needles. *u*. Chromicized catgut and silkworm gut. *v*. Long and short needles. Sponges, wipers, and ligatures are required.

the sphincter as to prevent the passage of the latter without great difficulty along the sinus into the gut; therefore the attempt to pass it should not be made until the muscular contraction ceases. It may be advisable to paralyze the sphincter by overdistention before dividing the sinus; this causes the




FIG. 1172.—*a*. Anus. *r*. Rectum. *b*. Complete fistula. *c*. Incomplete internal fistula. *d*. Incomplete external fistula.

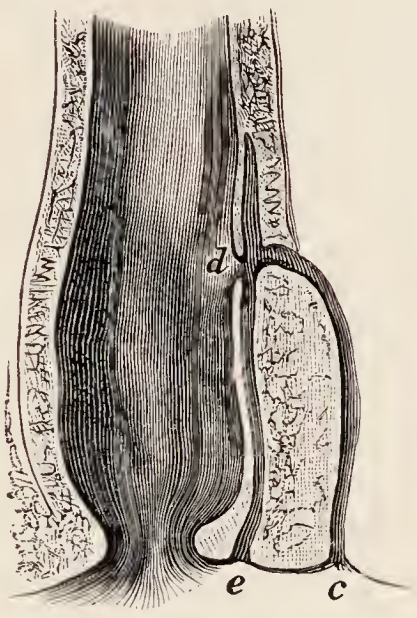



FIG. 1173.—Fistula in ano with dual openings (*c*, *e*).

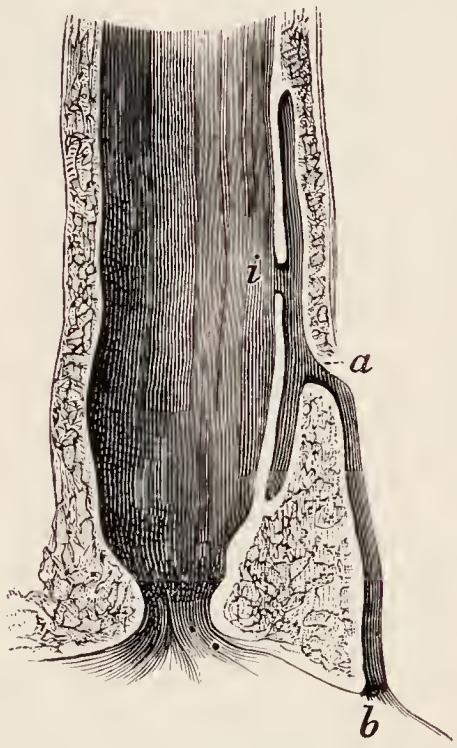



FIG. 1174.—Fistula in ano with extensive undermining of mucous membrane (*i*).

parts to remain at rest, adding to the comfort of the patient and hastening recovery. It can be accomplished by inserting the thumbs through the anus back to back, drawing them apart, or flexing the first joints and withdrawing the digits simultaneously (Fig. 1175), or by separation of them, or the use of a speculum designed for the purpose (Fig. 1176).

*The Operation Treatment.—The accepted plan of treatment*—division of the walls of the sinus—can be accomplished by *direct incision*, by *ligature*, or by the *galvano-cautery*. The first method is commonly employed.

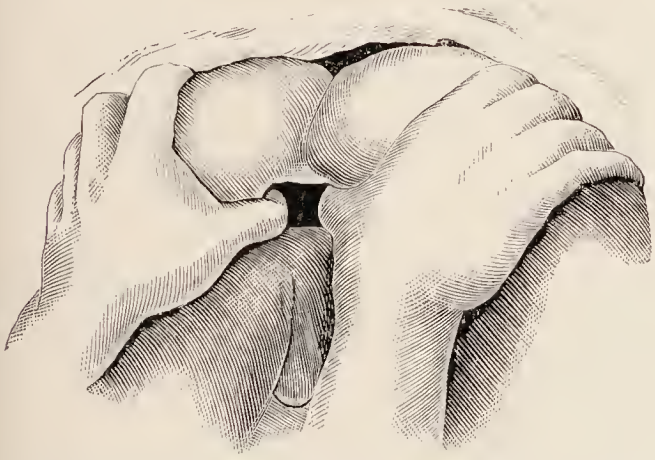


FIG. 1175.—The act of paralyzing the sphincter.

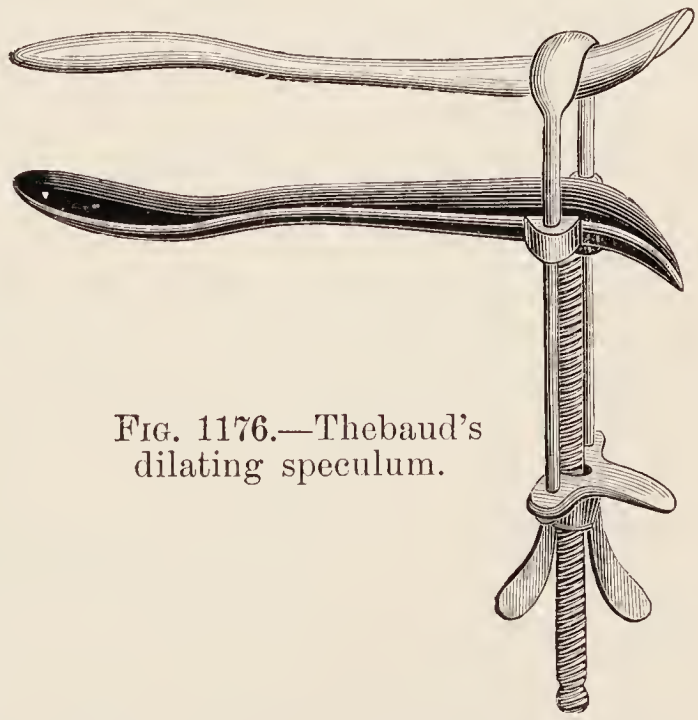


FIG. 1176.—Thebaud's dilating speculum.

For this purpose the bowel should be thoroughly evacuated by a brisk cathartic on the day preceding the operation, and a light diet should follow. On the day of the operation the bowel should be well cleansed by one or two copious enemata, which should have escaped before the operation is commenced.

*The Operation by Direct Incision.*—Place the patient on the back and give an anæsthetic; pass the finger into the bowel, as before described; introduce a grooved director through the sinus into the bowel; if the end of the director can be turned out (Fig. 1177), divide the sinus upon this instrument; if not, press its end against the finger, and pass a probe-pointed bistoury along the groove into the bowel, after which the director may be

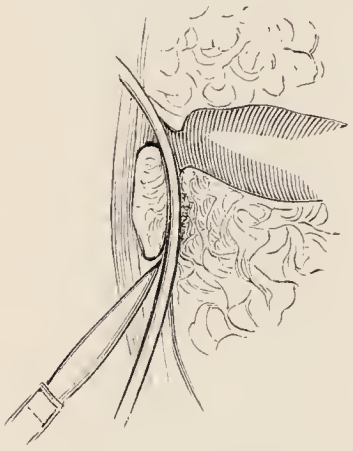


FIG. 1177.—Operation for fistula in ano, shallow sinus. End of grooved director turned out through anus.



FIG. 1178.—Operation for fistula in ano, deep sinus. End of finger in contact with extremity of grooved director.

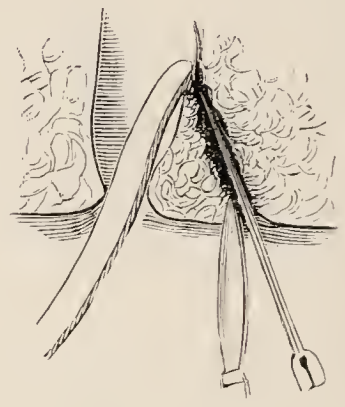


FIG. 1179.—Operation for fistula in ano. Piece of wood substituted for finger.

withdrawn, the point of the bistoury pressed against the finger and the sinus cut outward with the point thus protected (Fig. 1178). For the finger may be substituted a wooden director introduced into the bowel, by aid of which division is made (Fig. 1179). The scissors may be employed instead of the knife, either with (Fig. 1180) or without the grooved director. Whenever the depth of the sinus demands the division of the entire thickness of the internal sphincter, it should be done at right angles with the course of the fibers, to avoid, as far as possible, the danger of incontinence of flatus and fæces.

While each sinus should be opened, still, when possible to avoid it, the sphincter should not be divided at all; and, at all events, only at one situation at a time, in order that its integrity can be the better restored; when practicable, a small portion of the circular fibers should be preserved with the same object in view. It is not necessary to divide the walls of the abscess above the opening into the gut (Fig. 1174, *a*), since the drainage due to the division of the tissues below permits a rapid healing of this portion. As soon as the sinuses are opened, their pseudo-membranous linings should be scraped with a scoop or touched with a thermo-cautery, all hæmorrhage stopped, the cut packed with oakum, marine lint, or iodoformized gauze, a T-bandage applied, the patient placed in bed with limbs

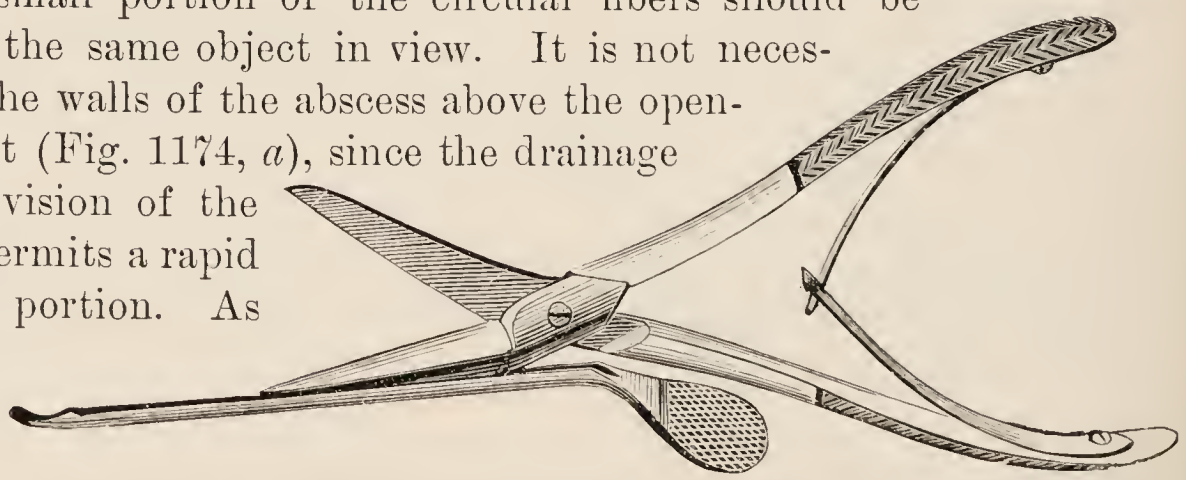


FIG. 1180.—Operation for fistula in ano. Allingham's director and scissors.

extended, and morphin or opium sparingly given to relieve all irritation and to produce passive constipation of the bowels. The wound is dressed once or twice daily, according to the demands of cleanliness, which should be strictly enforced. The food should be light, and not of a nature likely to leave a residue. In three or four days make use of a mild cathartic in conjunction with a copious enema to secure a fluid movement.

*The Precautions.*—Hæmorrhage of any importance is rarely seen—packing and ligature will readily control it; concealed hæmorrhage—i. e., free bleeding into the rectum—may be troublesome unless anticipated and prevented. Rapid healing of the freshly cut surfaces without repair of the fistulous canal should be prevented, otherwise the original character of the affection will soon be restored. The separation of the borders of the wound with a small amount of gauze or by frequent introduction of the finger will prevent premature union and foster granulation of the fistulous tract. On the other hand, too frequent dressing or firm packing, and walking about, may delay and even defeat repair of the parts. The devious courses of fistulæ should be followed and opened unless their course requires more than one division of the sphincter, when repeated operations at distinct intervals should be performed rather than imperil the sphincteric power by cutting all at a single sitting. A fistula in ano in tuberculosis often heals with difficulty and after much delay, especially if associated with local tuberculosis or great depression from constitutional involvement. The author is not disposed to operate on fistula in ano in tuberculous patients, unless the fistula itself constitutes a positive affliction.

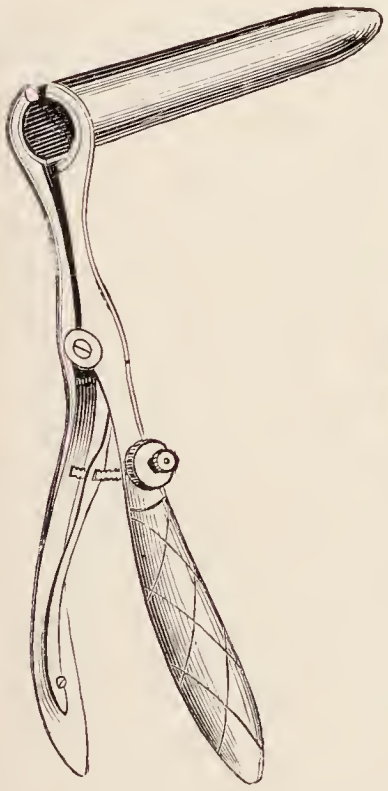


FIG. 1181.—Bivalve speculum.

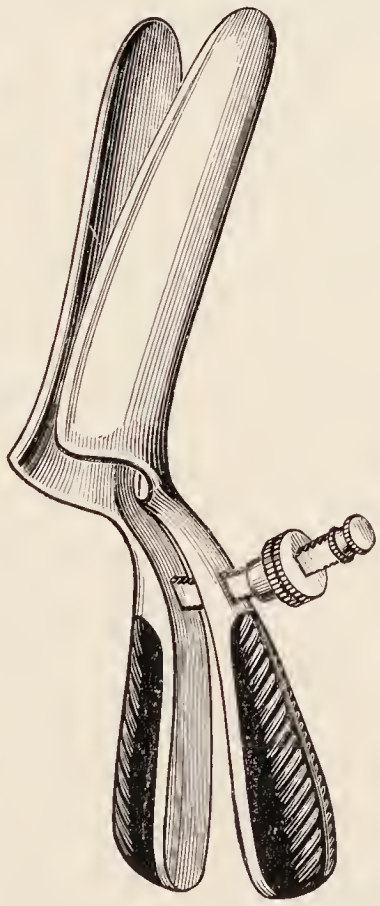


FIG. 1182.—Williams's rectal speculum.

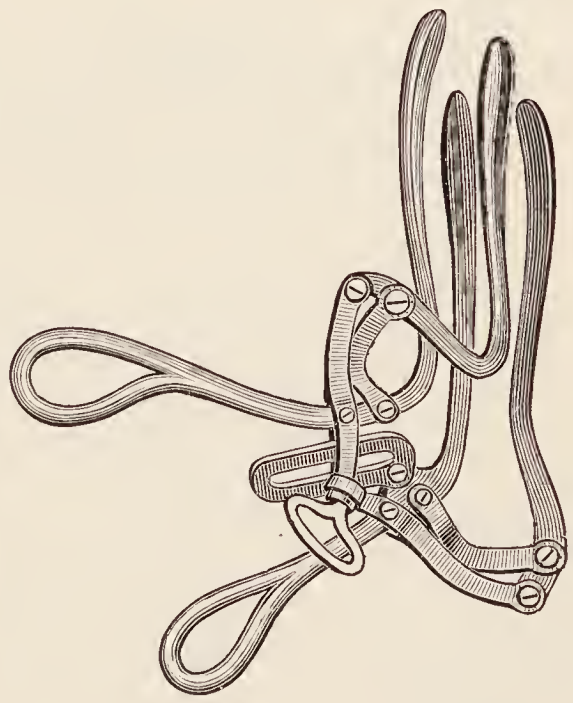


FIG. 1183.—Allingham's rectal speculum.

*The Comments.*—The walls of fistulæ should be scraped after division to facilitate healing, and all gristly, undermined, and granulation tissue and complicating hæmorrhoids removed. The detection of a communication

within is often difficult and even impossible except with the use of injections. The injection of milk, peroxide of hydrogen, or of a weak solution of iodine with starched gauze in the rectum, will reveal the slightest communication with the bowel, unless the opening within is closed by needless pressure. One of the various forms of rectal speculæ may be of service in locating the opening (Figs. 1181, 1182, and 1183). Fistulæ vary much in their extent and relation to the gut. The horseshoe (Fig. 1184) variety has an opening within and one at either side of the anus without, a sinus communication existing between the outer openings, and both communicating with the inner one (Fig. 1185). The internal sinus should be slit up by an incision which emerges at the skin margin at a point equidistant between the two other openings if possible. The curved sinus is then divided in either direction to the openings without involvement of the gut (Fig. 1186). Only one division into the gut should be made, unless more than one opening be present there, and the openings be independent of each other.

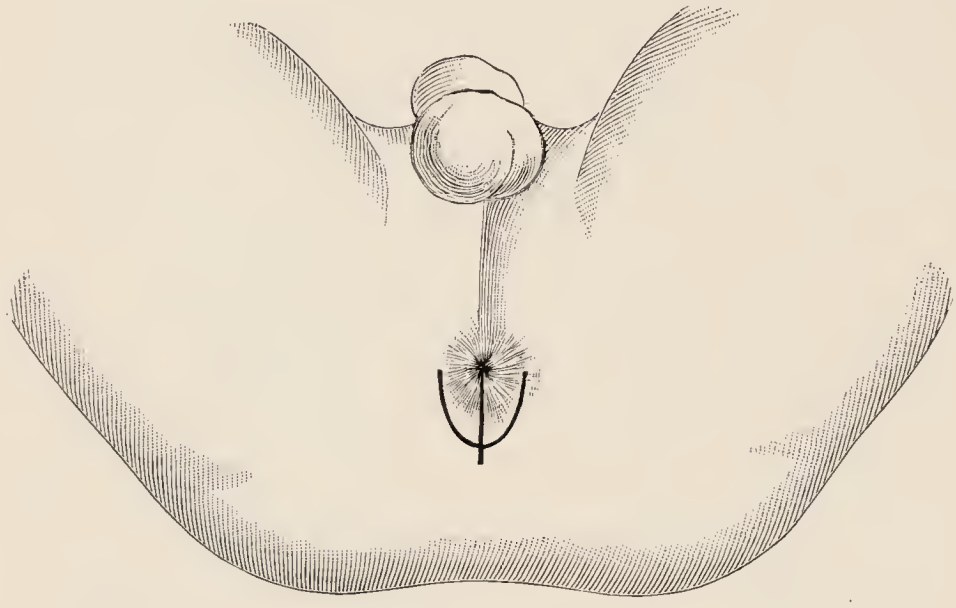


FIG. 1184.—Fistula in ano, equilateral horseshoe form. Line of incision.

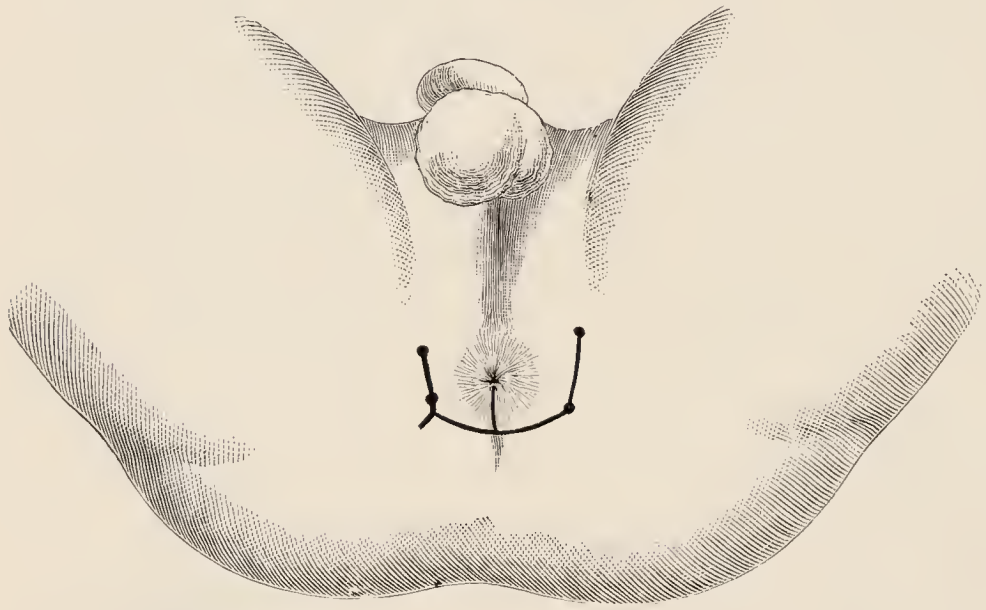


FIG. 1185.—Fistula in ano, equilateral horseshoe form. Line of incision.

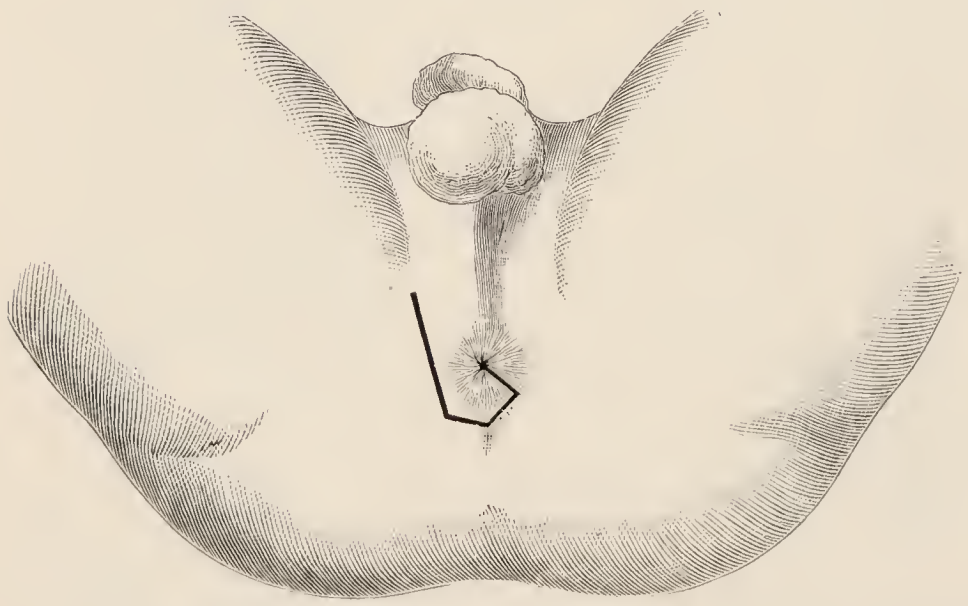


FIG. 1186.—Fistula in ano, irregular horseshoe form. Line of incision.

*Direct Incision with Closure* (S. Smith).—If the extent of the sinus will permit it, the entire tract should be removed by dissection and the resulting wound closed by catgut sutures carried deep enough to bring the walls of the wound in contact with each other. Two rows of chromicized catgut su-

tures should be employed: one, a deep row, which should bring the borders of the mucous membrane and the deeper structures together, while the other should unite the superficial parts. In this manner union by first intention may be secured, thus shortening the period of recovery, and obviating all danger of fæcal incontinence dependent upon the incomplete closure, which sometimes occurs when the cut is deep and is permitted to heal from the bottom. If, however, there be a cavity remaining at the upper end of the sinus, or if any portion of the fistula be not dissected out, the recovery by rapid healing will be retarded if not entirely prevented. The author has carried into effect the proposition of prompt closure of the wound by sewing in repeated instances, and usually with success. In no instance has harm ever followed the attempt. Great care should be exercised to secure fluid movements at first to prevent undue strain on the lines of suture.



Fig. 1187.—Allingham's rubber ligature carrier.

*The Treatment by Ligature.*—The elastic ligature is the only form worthy of consideration. The ligature consists of a rubber cord about one tenth of an inch in diameter. The cord is carried through the sinus into the gut by a special instrument (Fig. 1187), or by a long, large-eyed silver probe, so diverted as to escape at the anus (Fig. 1188), the inner extremity drawn out through the anus and the ends tied firmly together, after any integument which might be included in its grasp has been first divided, to prevent the pain and delay incident to the division of its peculiar structure by the constricting agent. The probe and a strong silk thread admirably meet the requirements, as the latter, after being passed through the sinus and attached to the rubber cord, may easily draw the latter into position. It is sometimes difficult to tie a knot securely in the rubber cord. Still, this can be accomplished easily by tying the first half of the knot over a silk ligature placed at right angles to the course of the elastic one, and then tying the silk ligature firmly around the half knot. This holds the elastic cord securely while the knot of the rubber cord is completed. The elastic ligature will cut its way through in six or eight days.

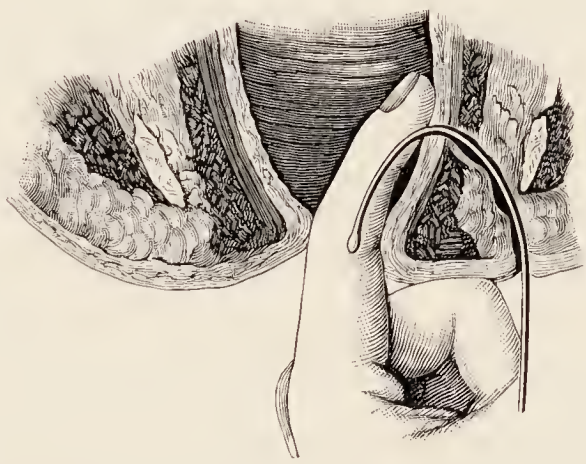


Fig. 1188.—Operation for fistula in ano. The probe as elastic ligature carrier.

This method possesses some advantages over that of incision, among which may be noted that, in simple cases, little or no pain is inflicted, and the patient can walk without any especial danger.

Timid patients refusing the use of the knife will often submit to the employment of the elastic ligature. The cure by ligature is not attended with bleeding, which is an advantage when vessels of unusual size may be implicated, or when an undue tendency to hæmorrhage exists. It is the best method in phthisical patients, for manifest reasons. It can be employed in all cases where but a single sinus exists; if, however, a second be present, the result must be of necessity unsatisfactory, as its employment then involves a repetition of the operation or the use of the knife.

*The galvano-cautery* (Fig. 102) does not secure better results than incision, and is much more cumbersome in its application; still, it is useful when dangerous hæmorrhage is apprehended.

*The Results.*—The death rate is difficult to estimate, because of the comparative innocence, but at the worst it forms no significant product of the procedure. However, certain sequels of the operation are of special significance.

*The important sequels of operation for fistula in ano* are incontinence of fæces and gas, and prolapse of the mucous membrane and possibly of the bowel as well. Various reasons are assigned for the condition that permits of their occurrence. Females are more subject to incontinence than males. Repeated, oblique, and high division of the sphincter and division at the junction with the sphincter vaginæ should be avoided if possible because of

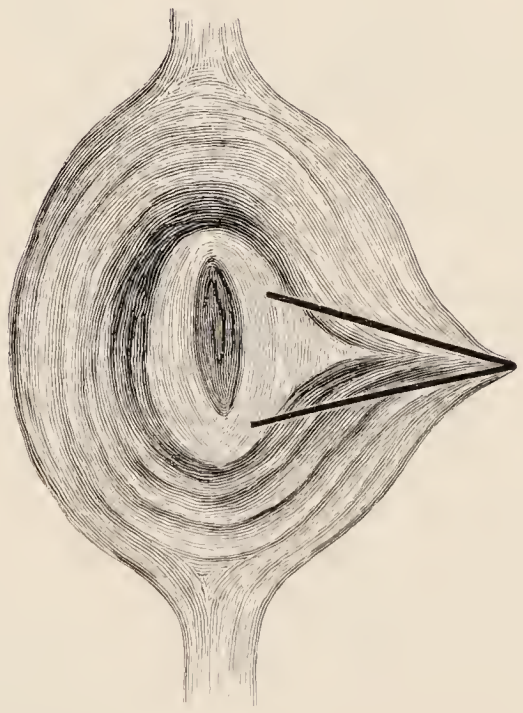


Fig. 1189.—Plastic operation for cure of incontinence of fæces, unilateral.

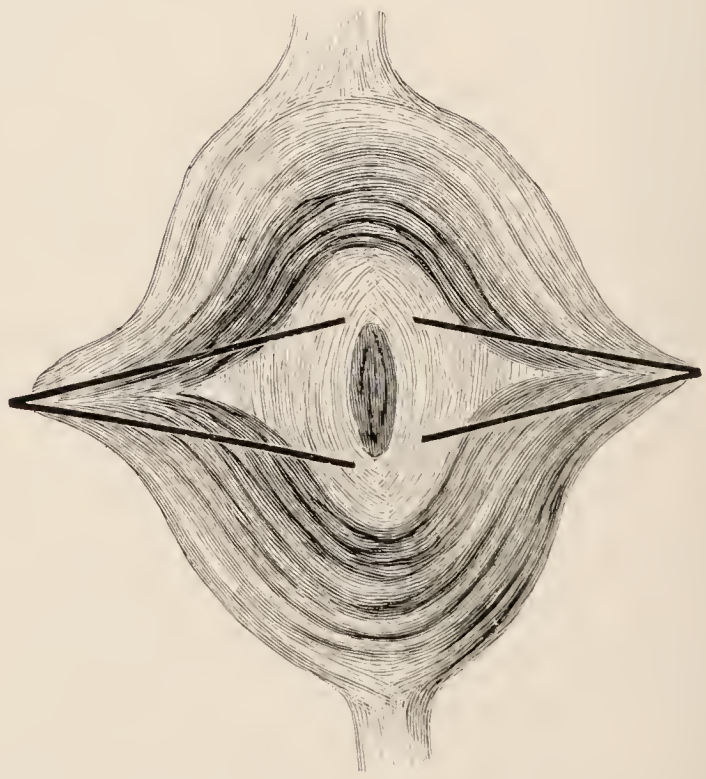


Fig. 1190.—Plastic operation for cure of incontinence of fæces, bilateral.

their liability to cause incontinence. Often after ordinary operations several weeks are required before complete control of the sphincter is secured. Irrespective of the cause, they are best obviated by a limited impairment of the sphincter, and close union and prompt healing of the divided ends

at the time of operation. *Two methods of cure are recommended:* 1, the employment of plastic repair; 2, the use of the actual cautery. *In the former method* a V-shaped incision is made with the apex outward and with the lines of incision so directed as to expose the divided ends of the sphincter (Figs. 1189 and 1190), which are then freshened and drawn together by means of sutures passed deeply and retained in place during healing of the wound. The anal mucous membrane at the base of the triangle should not be divided, as it serves to protect the severed tissues from infection, and affords of itself a limited obstacle to the escape of rectal matter. And especially is this true if the membrane be separated from the subjacent tissues and drawn downward and stitched to the anal border at the seat of repair of the sphincter. Vertical subcutaneous division of the inner fibers of the sphincter, at a little distance from either side of the line of union of the divided ends, will sometimes aid the final repair, by lessening the tension of the inner and shorter sphincteric fibers. The secondary divisions heal promptly.



FIG. 1191.—Operation by cauterization for cure of incontinence of fæces.

*In the latter method*, deep, outward radiating divisions are made with actual cautery, with or without linear cauterization of the mucous membrane of the lower end of the rectum, at points corresponding to the inner extremities of the radiating incisions (Fig. 1191). The radiating burns extend from within the anus outward for an inch, down to the sphincter. In any method of repair the anus and rectum should be kept as quiet as possible, and perfect cleanliness enforced. The many details of the technique of repair will be found only in treatises devoted especially to rectal disease.

**Hæmorrhoids.**—A varicose condition of the ano-rectal veins is a frequent affection, to which the term hæmorrhoids or piles is applied. *Two distinct varieties* of hæmorrhoids are recognized—external and internal hæmorrhoids. A combination of the two—intero-external—is not infrequently seen. The external are located without the bowel and are intimately connected with the anal border. The internal are located within the bowel and are not seen externally except when prolapsed. In either situation the growths vary in shape, size, and extent of attachment. External piles are usually globular, with a sessile or pedunculated base, and an inner mucous and outer cutaneous surface. Internal piles may be either pedunculated, sessile, columnar, etc., shaped according to the degree and extent of the dilatation. Prolapsus ani (Fig. 1206) sometimes attends the hæmorrhoids.

*The preparatory treatment* consists in securing a free evacuation of the bowels twenty-four or thirty-six hours before operation, followed by an enema the night before. Care should be taken to eliminate from the rectum any retained fæces or fluid injection, so as to avoid the unpleasant catastrophe and wound infection that might happen from an unanticipated discharge during operation.

*Various operative methods of treatment* have been devised for cure of hæmorrhoids, the most important of which are by: *a*, incision; *b*, excision; *c*, ligature with excision; *d*, crushing; *e*, clamp and cautery; and *f*, injection.

**The Incision Method.**—Incision is employed in the treatment of recent inflamed and distended hæmorrhoids. After thorough cleansing of the parts place the patient on the side, with the thighs flexed on the abdomen and the nates separated; seize the tumor between the thumb and finger and slit it open from within outward in the direction of the radiating folds of the anus with a sharp-pointed curved bistoury; turn out the clot, cleanse the wound, and pack it gently with iodoform gauze, to exclude infection and prevent premature union. Under the influence of daily dressing and quiet, a rapid and safe cure ensues.

**The Excision Methods.**—Excision alone is employed in the removal of quiescent hæmorrhoids, and, combined with ligature, is practiced in the removal of both limited and extended hæmorrhoidal growths. The integumentary tabs—the sequel of external piles—can be cut off directly, on a line with the surface to which they are attached, with scissors. The little hæmorrhage that follows is easily controlled and healing facilitated by closing the cut surface with a suture or two of fine catgut. Not infrequently, however, in this class of cases the hæmorrhoids become distended again with blood, very œdematous, exceedingly painful, and in rare instances gangrenous. They are then readily removed by ligature and excision, or clamp and cautery. Also direct excision can be practiced in those cases in which three or four well-defined tumors with distinct bases are present, by seizing the tumor at the base with narrow forceps, and, while the base yet remains in the grasp of the instrument, the pile is removed. The base is twisted or tied as may be needed, to prevent bleeding. The following method is much better than this one in this class of cases.

**Allingham's Method** (*Longitudinal Excision and Ligature*).—Give an anæsthetic, place the patient on the back with the buttocks near the edge of the table, thighs flexed and separated with the Clover's crutch and nates drawn apart. Dilate the sphincter completely; expose the lower three inches of the rectum with a speculum; seize the lower end of each hæmorrhoid in turn with forceps, draw it downward, and with a pair of strong scissors separate it from the underlying tissues in the long axis of the bowel by cutting and dissecting from the muco-cutaneous junction upward to the apex of the pile, at which point it is tied with a strong silk or catgut ligature and removed.

*The Remarks.*—The point grasped by the ligature is an "isthmus of vessels and mucous membrane." The normal direction of the vessels renders the separation easy and comparatively bloodless unless the vessels be

divided. Loose skin is snipped off and the cut closed in with fine catgut sutures. On numerous occasions the writer has closed with fine catgut the furrows in the mucous membrane resulting from the removal of the hæmorrhoids. The growths having a distinctly columnar outline are the ones best fitted for this method of treatment.

**Whitehead's Method** (*Circular Excision and Ligature*).—Whitehead's method of operation consists in excision of the pile-bearing tract. Place the patient in the lithotomy position, using Clover's crutch (Fig. 1393); dilate the sphincters fully; divide carefully the mucous membrane around the anal opening at its junction with the integument; with forceps and scissors expose the inner border of the external and the beginning of the internal sphincter; separate the attached membrane and the associated hæmorrhoids from these muscles and the subcutaneous tissue by rapid blunt dissection, and occasional division of restraining bands, and draw it downward below the anus; sever the mucous membrane above the hæmorrhoids in successive parts, and sew them at once to the corresponding portions of the anal margin of the integument with silk; dust the parts with iodoform and place the patient in bed.

*The Precautions.*—Care should be taken to divide the mucous membrane *at its junction* with the integument, as failure in this respect is often followed by annoying sequels. The line of union of the divided mucous membrane with the cutaneous border of the anus should not be taut, as a resulting separation will be succeeded by the annoyances of healing by granulation, and perhaps later by narrowing of the anal opening.

*The Comments.*—The primary incision is begun at the most dependent part, and follows closely the muco-cutaneous junction throughout the entire circumference of the opening. The sphincteric borders should be carefully determined, and the deeper tissues cautiously separated to prevent hæmorrhage. The separation should extend above the affected area—an inch or two—so as to facilitate downward displacement and ready union of the healthy border of the mucous membrane with the integumentary margin without danger of undue subsequent traction. The bleeding of the operation is attendant mainly on division of the mucous membrane, and although comparatively profuse is in no wise dangerous; it is best controlled by fine catgut ligatures securely tied. The introduction into the anus of a small plug made of iodoformized gauze (Fig. 1171, *e*) wrapped around a catheter or rubber tube, for the purpose of causing coaptation of the tissues, and at the same time permitting the escape of gas, is sometimes practiced for a brief time following the operation. However, the presence of this foreign body is commonly disagreeable to the patient, and often causes absolute discomfort because of its presence and the sphincteric contraction it sometimes excites. The division and sewing of the mucous stump in sections enables the operator to maintain complete control of the bowel, and estimate properly the degree of tension at the line of union. The removal from the anal extremity of the mucous membrane endowed with special sensibility is, for physiological reasons, regarded as objectionable to this plan of action. Severe cases can be cured with equal promptness, less suffering and danger of annoying com-

plications and sequels by simpler methods. Pronounced engorgement of the veins without special tumor formation can well be treated by this method.

*The Results.*—In the hands of operators skilled in the method the results are reported as excellent. However, in those not familiar with the technique, such sequels as ulcer, stricture, neuralgia, pruritus ani, and even incontinence of flatus and fæces are reported.

**Ligature.**—Ligature and excision go hand in hand, because points of actual and anticipated bleeding here can be controlled quickly by ligature, and tissues strangulated by ligature should be removed by cutting, for obvious reasons. In connection with ligature of hæmorrhoids, it now remains to speak of treatment by submuco-cutaneous and transfixion ligature of these tumors, followed by excision.

*Pass submuco-cutaneously* a chromicized-catgut suture, seize with a hook, lift up and sever the hæmorrhoid, tightening the ligature at the time. Finally, tie securely, thus converting the hæmorrhoidal site into a simple incised wound with securely apposed borders (Fig. 1192).

*An Old Method.*—Seize the pile with forceps at the base, transfix it with a needle bearing a double ligature; interlock the ligatures, tie the tissues firmly in halves, and cut off the strangulated growths. This is a rapid and safe method when conducted with due aseptic regard. The loss of blood is slight, and for these reasons the practice is indicated in feeble and aged patients affected with large and well-formed piles.

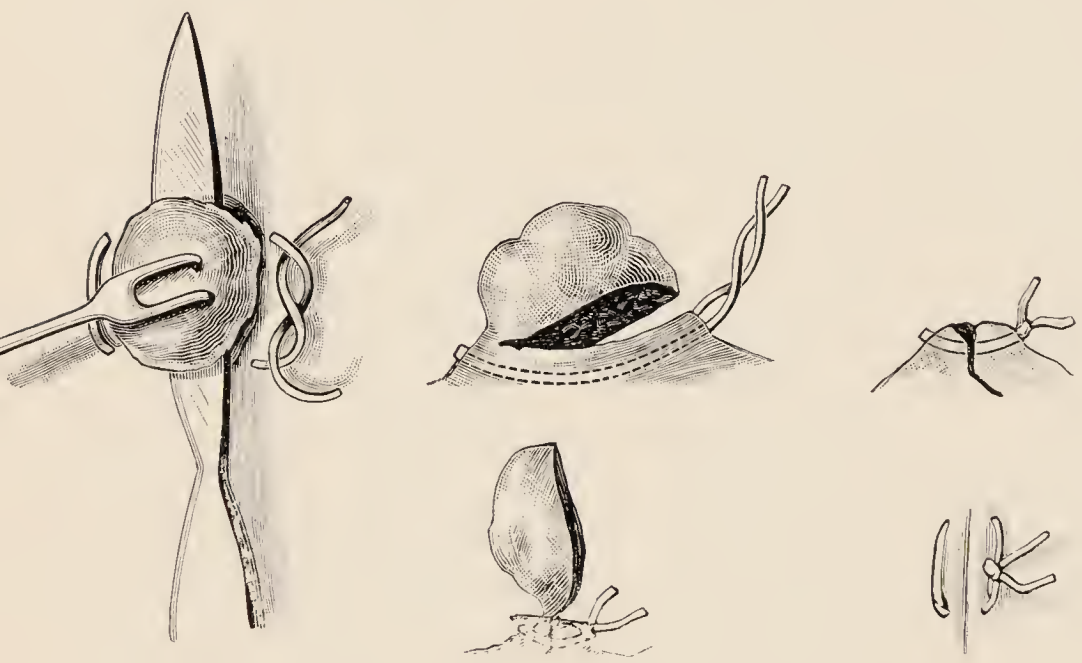


Fig. 1192.—Operation for the cure of hæmorrhoids. Submuco-cutaneous ligature and excision.

*The Remarks.* — In this method, as in others of like nature, the too free removal of mucous membrane is likely to be followed by narrowing of the anal orifice. The sequel can be prevented by leaving between the respective ligatures independent areas of mucous membrane. The contraction attending the cure will remedy the small, untied hæmorrhoids. If too large for this purpose, they may be punctured with the heated points of a Paquelin cautery without causing objectionable contraction of the mucous membrane.

**Coates's Method.**—Seize the pile with forceps and draw it down, and apply to the pedicle a long, narrow clamp; pass beneath the clamp a proper number of sutures of fine catgut; excise the pile, loosen the clamp, check bleeding, remove the clamp and tie the sutures tightly.

**The Crushing Method** (Pollock).—The crushing method consists in crushing the pedicle of the growth by an improvised instrument or one especially

constructed for that purpose (Fig. 1193). This method is not suitable for universal application, but rather for those tumors that possess well-defined bases. The integument, if it be connected with the tumor, should be incised, otherwise great pain will follow.

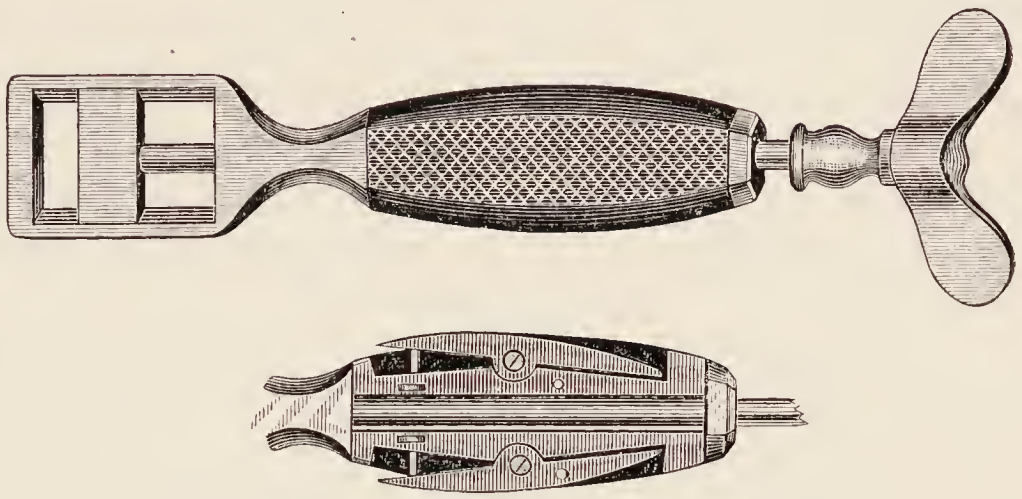


Fig. 1193.—Allingham's instrument for crushing hæmorrhoids.

*The Operation.*—The patient is prepared, as in the preceding instances; the pile is pulled between the bars of the instrument by the aid of a hook or a volsella, after which the screw is turned tightly against it. The projecting portion is then cut off. The instrument is retained in position for half a minute or so to insure against the danger of hæmorrhage. While this method may be classed among the satisfactory ones, it possesses no superiority over the treatment by ligature, and, as a rule, causes more pain, permits a less speedy recovery, and exposes the patient to a greater danger of subsequent hæmorrhage.

**The Clamp and Cautery Method** (Cusack).—The method by clamp and cautery is strongly advised by many eminent surgeons, and surely the promptness and efficiency of the practice can be highly commended.

*The Operation.*—With the patient under an anæsthetic, in the lithotomy position and with the sphincter dilated, seize the tumor with the forceps, and draw it from the anus or expose it with a speculum; divide the cutaneous surface, if present, with blunt-pointed scissors or a knife; apply the clamp (Fig. 1171, *q*) to the base of the tumor in the long axis of the gut, including the cutaneous sulcus if present, and screw the blades firmly together; cut away the tumor with scissors and cauterize the stump deliberately with red heat (Paquelin cautery); loosen the clamp, and, if bleeding occur, close it and cauterize again. The tumors are thus treated one by one until all are removed.

*The Remarks.*—The tissues should be slowly and thoroughly charred, otherwise hæmorrhage will take place. If the growths be large the clamp should not grasp the tissue quite down to the anal junction for fear of causing subsequent contraction. However, in cases with relaxed sphincter this precaution is not of so much importance. Care should be exercised not to burn the integument, as such injuries are very troublesome.

*The Results.*—This operation is quickly performed and the results are very satisfactory. Caution is needed to note the entire absence of bleeding before the patient is removed to bed, as much blood may accumulate in the bowel without the least escape from the anus.

**Injection.**—The injection of carbolic acid and of astringent agents, together with the application of caustics, are not entitled to the dignity of rank sometimes accorded to them. The occasional severe inflammatory

reaction, often followed by abscesses and gangrene, and the fickleness of cure unfit these measures for trustworthy station with the methods of cure.

*The General Remarks.*—In instances of excision or ligature of hæmorrhoids having a cutaneous surface, the cutaneous surface should be divided in the line of the proposed constriction with a knife or blunt-pointed scissors—the latter being the better—before tying is attempted. If this be not done, the degree of pain incident to tying in of the skin will be severe and quite persistent.

In those cases characterized by a rosette arrangement of the hæmorrhoids completely around the bowel within the anus, the circular mass should be divided into five or six segments and separately ligatured. The segmentation can be executed by means of a grooved director through a small incision in the mucous membrane made at either side of the pile, or by direct incision, or transfixion with a needle armed with a ligature. When properly isolated the segments are tied separately with silk or chromicized catgut.

The transfixion and tying of hæmorrhoidal growths is regarded by many as improper practice. It is claimed that a needless amount of tissue is included, that vessels are punctured and infection invited by the practice. The writer is not disposed to regard the measure as objectionable in isolated tumors with thorough asepsis, and has practiced it not infrequently, and thus far without an unfavorable result.

General anæsthesia meets the requirements more completely than local; the latter, however, is sufficient in the simplest cases. Catgut ligatures are liable to slip and be followed by hæmorrhage; silk ones are safer, but more likely to be annoying because non-absorbable. Narrowing of the anus rarely follows in ligature or cautery except the integument be encroached upon. Dependent incisions should be made first, to avoid obscurement of the line of incision by blood. The strength of ligatures should be tested before applying them to the hæmorrhoids. Temporary retention of urine is a frequent sequel of operation for hæmorrhoids, and the occurrence should be anticipated and provided for in each instance.

*The choice of operation* is largely a matter of personal experience. The author employs excision and ligature after the manner of Allingham, and ligature alone by transfixion more frequently than he does the other methods, and thus far without regret. The excision of the pile-bearing tract is a logical procedure and in extensive involvement at the anus is widely practiced. Mr. Whitehead, the designer, and others have performed it on numerous occasions with excellent primary and final success. The clamp and cautery plan is a good one, especially in well-defined growths, and is ably advocated by Kelsey of this city.

*The after-treatment* is simple and consists of the application to the anus of iodoform; a cotton pad held in place with a T-bandage; opium for pain and spasm. The patient should be kept quiet in bed for four or five days and cleanliness of the parts secured. About this time obtain a good movement with oil supplemented with a simple enema. The preliminary diet should be devoid of solid food.

*The Results.*—The death rate in St. Mark's Hospital "from all causes in operations on internal hæmorrhoids by ligature during a space of more than forty years is just 1 in 670" (Allingham). *Allingham* reports over 1,600 cases of his own with but a single death. Other surgeons of extensive experience make similar favorable reports. Where properly performed the affection seldom returns and then only after many years.

**Operations on the Rectum.**—The protected position of the rectum exempts it from many of the common injuries to which the abdominal contents are exposed. However, disease of this bowel is sufficiently frequent to demand its careful consideration.

*The Anatomical Points.*—The rectum is about eight inches in length, varying according to the height of the individual. As usually described it extends from the left sacro-iliac synchondrosis to the anus. It has three portions and three curves. *The first portion* extends from the synchondrosis to the middle of the third sacral vertebra. It is about three and a half inches in length and surrounded almost entirely with peritonæum. Posteriorly it is in relation with the pyriformis muscle, sacral plexus, and branches of the internal iliac artery on the left side, which lie between the gut and the sacrum, and sacro-iliac junction. The prerectal pouch, containing small intestines, lies in front. It is proper to say at this time that the first portion, as ordinarily described, is regarded by Treves as the continuation of the sigmoid flexure. According to this the rectum begins at the third sacral vertebra, or where the mesocolon disappears. The *middle* portion is about three inches in length. It begins at the ending of the first portion and terminates at the apex of the prostate, an inch below the level of the tip of the coccyx. It is covered by peritonæum in front at its upper part, which is reflected from its anterior surface to the bladder in the male about an inch above the base of the prostate. It rests on the sacrum and coccyx behind, and is in contact with the trigone of the bladder, prostate, seminal vesicles, vasa deferentia in the male, and the posterior wall of the vagina in the female, in front. The *lower portion* is about an inch and a half in length, and extends from the apex of the prostate to the anus. In front a wedge-shaped mass of tissue intervenes between it and the bulbous portion of the urethra in the male, and similarly between it and the vagina in the female.

*The Three Curves.—The first curve*, an inch and a half in length, extends from the anus to near the prostate, and is directed upward and forward—a fact which should be remembered in the introduction of instruments. *The second curve* follows the curve of the sacrum, and is about three inches in length; the greater portion of this curve is covered with peritonæum, which is reflected upon it at a level of about two and a half inches above the anus in front, and about five inches behind, when the bladder and rectum are empty; if the latter are filled, the distance is increased about an inch. The anterior surface of the lower part of this curve is intimately associated with the base of the bladder, vesiculæ seminales, and prostate body in the male, and the posterior wall of the vagina in the female. *The third curve* extends from the middle of the third piece of the sacrum to the left sacro-

iliac synchondrosis. This curve is almost entirely surrounded by serous membrane. The arteries having surgical associations with the rectum are the superior, middle, and inferior hæmorrhoidal arteries. The first is the

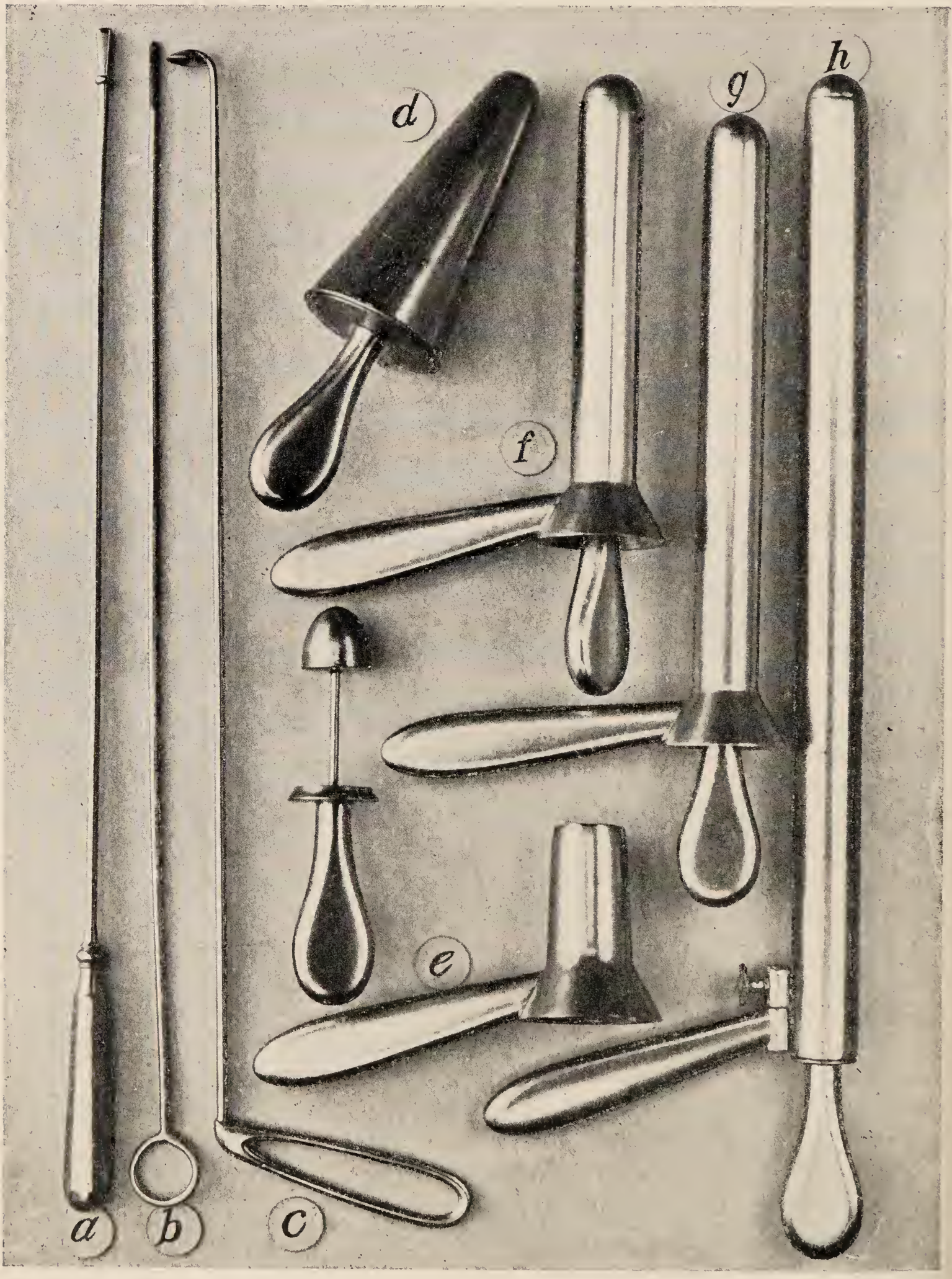



Fig. 1194.—Instruments employed in examination of the lower bowel.

*a*. Sponge holder. *b*. Applicator. *c*. Curette. *d*. Anal dilator. *e*, *f*, *g*. Proctoscopes, assorted lengths. *h*. Sigmoidoscope. Various forms of rectal specula (page 953) may be employed in examination of the lower part of the rectum.

most important; it runs between the rectum and the sacrum, a little to the left of the median line, to within about four or four and a half inches of the anus, a fact that should be remembered in making high incisions of the rectum.

The arteries in the upper half pierce the muscular coat, forming a capillary network in the submucous tissues; in the lower half the vessels take a longitudinal course to the anus and anastomose there through transverse branches. This longitudinal arrangement explains the reason why longitudinal incisions of the rectum bleed so little and transverse ones so freely. The veins follow the course of the arteries, forming a plexus at the lower part of the bowel which empties its blood into the internal iliac and inferior mesenteric veins. The relations of the tissues to the vessels and direction of the veins at the lower two or three inches of the bowel explain the location of hæmorrhoids and their relation to the arteries and submucous tissues. The lymphatic channels connect with the glands of the sacral and lumbar regions. Sphincteric contraction is manifest throughout the lower inch of the bowel. An inch and a half above the anus the free border of the levator ani muscle can be felt posteriorly.

**Rectal Examination.**—Two methods of direct rectal examination are practiced: 1, by the fingers, specula (Fig. 1194), light, etc., aided by the position of the patient; 2, by the introduction of the entire hand.

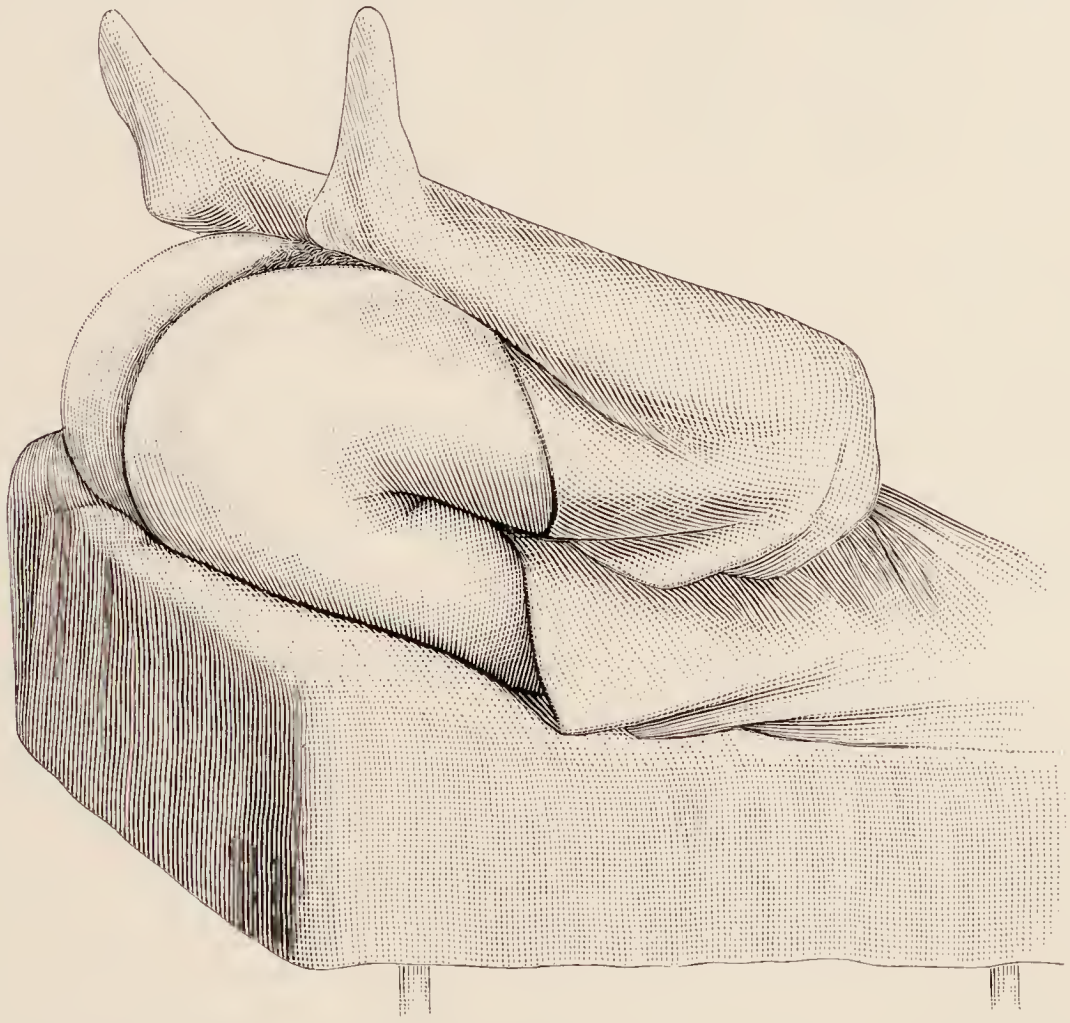


Fig. 1195.—The exaggerated lithotomy position for examination of the anus and rectum.

*In the former method,* cleanse the bowel thoroughly and empty the bladder; place the patient in the latero-prone or the exaggerated lithotomy or knee-chest position, depending on the scope of the examination. If only digital examination be intended the first will suffice. Oil the index finger

and introduce it gently with a semirotary motion, allowing the remaining fingers to remain between the nates. By this method the lower four or five inches of the gut can be palpated with the use of moderate force. The extent of the examination is increased somewhat if the patient bear down. The introduction of the middle finger along with the index adds still more to the extent of the examination. An educated touch will enable the surgeon to comprehend with astonishing exactness the physical state of the rectum and its surrounding structures. The use of a speculum, aided by a good light, will permit observation of the lower half of the gut. However, to secure a more thorough and extended inspection, place the patient in the exaggerated lithotomy position (Fig. 1195); then draw backward the posterior wall of the rectum with a Sims's speculum; press the anterior wall forward with a uterine or a special depressor, or the handle of a tablespoon, when, with the aid of a good light—electric or otherwise (Fig. 103)—the lower four or five inches of the rectum can be quite well seen. The use of a small, soft sponge on a sponge holder will aid much by smoothing out the folds of the bowel and wiping its surface clean. Under the influence of a strong light and the bowel well distended with air, three valves, and sometimes four, are observed. The largest and most constant is usually connected with the anterior wall at a point opposite the neck of the bladder and about three inches from the anus. The second largest is attached to the right wall of the bowel near to the upper end of the rectum. The third midway between the preceding at the left wall of the gut. When present, the fourth arises toward the left from the posterior wall and is about an inch above the anus. The fact that they may be mistaken for evidence of disease and often do become the seat of diseased action prompts the giving of this somewhat detailed description. The bowel can be examined yet higher by placing the patient in the knee-chest position (Fig. 1196) and employing the long proctoscope (Fig. 1194, *g*) or the sigmoidoscope (*h*), supplemented by a strong light and a head mirror.

2. *The Introduction of the Entire Hand.*—The introduction of the entire hand must be done with great caution in order not to lacerate the bowel or the peritonæum enveloping it. For this purpose the patient is placed upon the back, anæsthetized, bladder emptied, and the services of a person with a small hand, *not exceeding eight inches in circumference*, are enlisted. The hand is well oiled, and given a conical form by applying the thumb to the palmar surface of the approximated fingers. The tips of the fingers are then carefully inserted by a semirotary motion, which is slowly continued until the whole hand enters the bowel. After the entrance of the hand, the fingers are moved in various directions to ascertain the caliber and condition of the gut, and, at the same time, to favor the circulation of the imprisoned hand.

If the hand meet a narrowing of the bowel at a distance of three or four inches above the anus, but little force should be used, as the peritonæum, which is connected with the gut in this situation and is the probable cause of the narrowing, may be ruptured. If the hand be unusually small, it not infrequently happens that the sigmoid flexure may be passed, the descending colon entered, and the kidneys, uterus, and great vessels, etc., be intelligently

examined. It is, however, extremely fatiguing to the examiner; still, the discomfort experienced should not lead the surgeon to relax in the least the degree of caution necessary to the safety of the patient.



Fig. 1196.—High examination of the bowel, patient in knee-chest position.

**Ischio-rectal Abscess.**—Abscess of the ischio-rectal fossa is of comparatively common occurrence. Its chief surgical importance relates to fistula in ano. The abscess may be caused by perforation from within the bowel, and therefore when incised from without leads to prompt development of a complete fistula in ano. On the other hand, if the abscess have no internal communication at the outset, one may soon develop from localized sloughing of the intestinal wall from suppuration.

*The Anatomical Points.*—The ischio-rectal fossa is located between the end of the rectum and the tuber ischium at each side (Fig. 1198). It is triangular in shape, the base corresponding to the perinæum and the apex to the point of origin of the anal (*g*) from the obturator fascia (*f*). The ischio-rectal fossa is about an inch in width at the base and two inches in depth, being deeper behind than in front. It is limited in front by the junction of the deep and superficial perineal fasciæ, behind by the gluteus maximus muscle and the great sacro-sciatic ligament. It is filled with adipose tissue, through which run hæmorrhoidal vessels and nerves and branches of the internal pudic, sometimes of large size. Also a branch of the fourth sacral nerve is found at the back part of the fossa, and the superficial perineal vessels and nerves at the front.

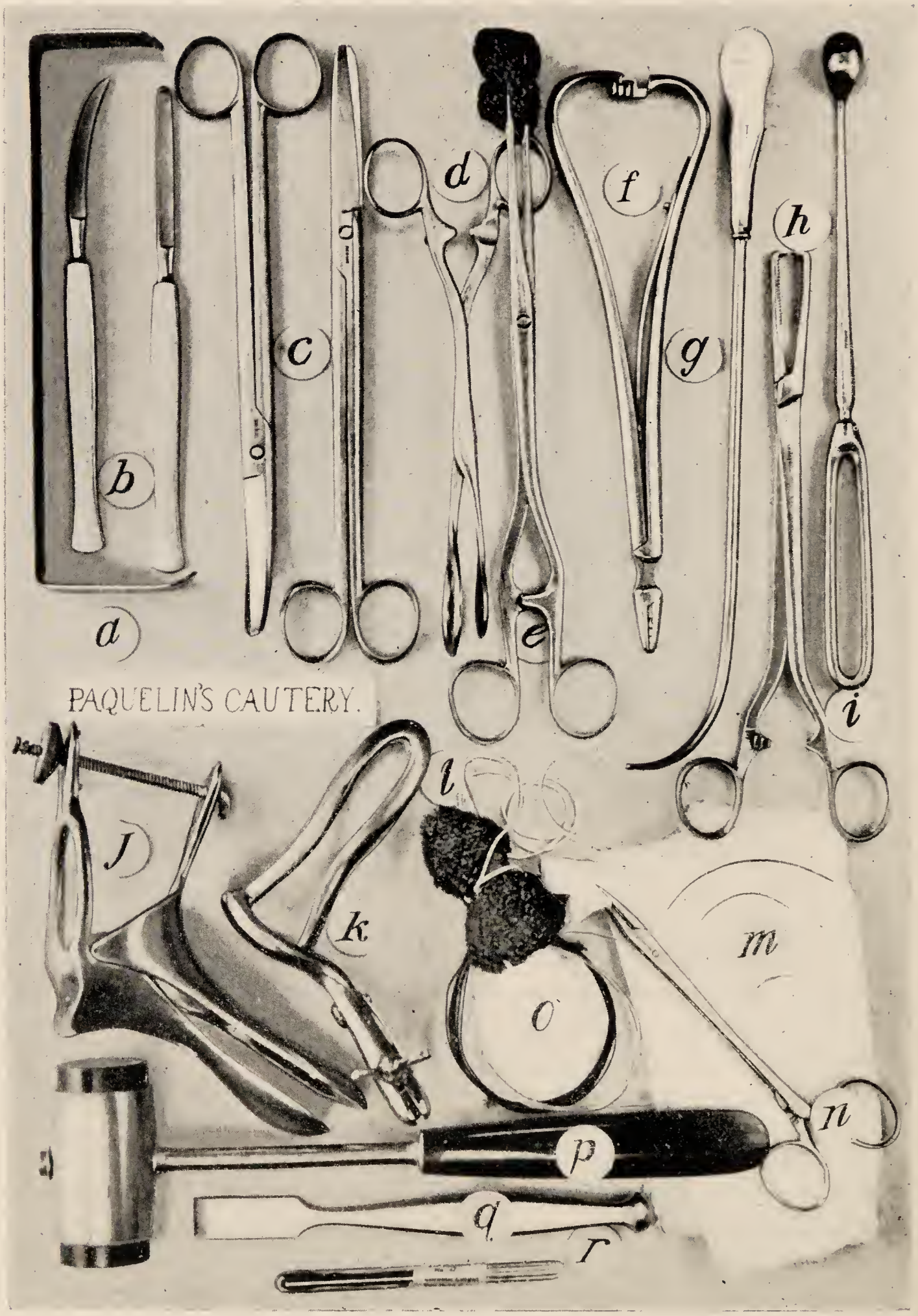



FIG. 1197.—Instruments employed in operations on the rectum.

*a*. Blunt flat retractor. *b*. Curved and straight blunt-pointed bistouries. *c*. Long straight and curved scissors. *d*. Tongue forceps for grasping rectum. *e*. Sponge holder. *f*. Needle holder. *g*. Steel sound. *h*. Forceps for grasping bowel. *i*. Scoop. *j*. Duckbill speculum. *k*. Fenestrated speculum. *l*. Sponge with string attachment for closing bowel above. *m*. Long and short needles. *n*. Aseptic pad anchored. *o*. Chromicized catgut and silkworm gut. *p*. Mallet. *q*. Chisel. *r*. Black silk. Scalpels, ligatures, wipers, forcipressure, and blunt dissector are required.

*The Operation.*—Thoroughly cleanse and shave the perinæum; employ local or general anæsthesia as circumstances demand. The situation, direction, and extent of the liberating incisions will depend on the location and extent of the abscess. If the abscess be superficial, either antero-posterior or radiating incisions are suitable. If deep, the radiating should be employed, carefully avoiding the sphincter ani and the internal pudic vessels. Circumscribing incisions should be avoided. If abscess be in front of the rectum a transverse perineal incision in the male and vaginal incision in the female may be required. If behind, or at the side of the bowel high up, a posterior median incision may be needed. In all instances the finger should

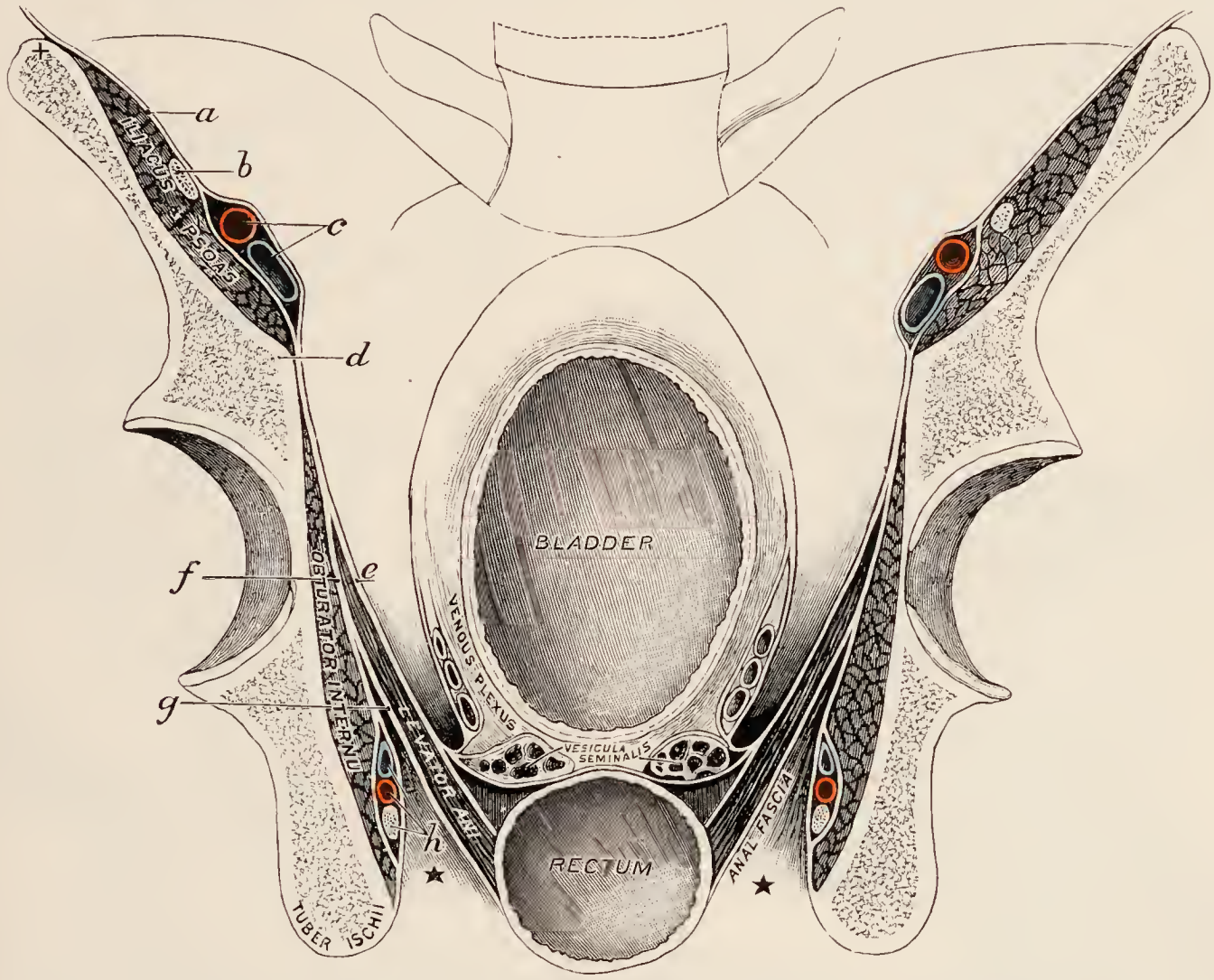



FIG. 1198.—The ischio-rectal spaces and contiguous anatomy. *a*. Iliac fascia. *b*. Anterior crural nerve. *c*. Iliac vessels. *d*. Brim of pelvis. *e*. Recto-vesical fascia. *f*. Obturator fascia. *g*. Anal fascia. *h*. Internal pudic vessels and nerve. * Ischio-rectal fossæ. † Anterior superior spine of ilium.

be carried into the opening and search made for channels and pockets, exploring freely in every direction. A single cavity may be formed if practicable; if not, the side pockets should be drained by suitably located incisions. Thorough cleansing and light packing with gauze should follow, being repeated during the healing process as frequently as cleanliness and good drainage require.

*The Remarks.*—Abscess may develop between the recto-vesical and anal fascia (*h*), and at either side between the levator ani muscle and the base of the bladder, or it may extend from the ischio-rectal fossa to these situations. An ischio-rectal abscess may be of limited size, located at any part of the fossa or invade the entire space. The devious curves pursued by the suppuration, and the greater need of care to secure good drainage call for the

exercise of patience in the detection and drainage of the suppurating recesses. The sooner and freer the openings are made the less will be the extent of the invasion and the prompter the recovery. If the abscess has come from internal perforation the fact should be determined at once, and time and annoyance saved by immediate treatment of the fistulous opening.

**Imperforate Rectum** (Figs. 1199 and 1200).—The occluding tissue in imperforate rectum varies in thickness, and is usually situated within half an inch of a normal anus. If the septum be thin, it will be influenced by the emotions of the child and depressed by the superimposed fæcal accumulations; also evidences of fluctuation may be present. At all events, the use of an aspirating needle will aid much in settling the question of thickness. Intraperitoneal exploration by either the sacral or perineal route for diagnosis is commendable practice. The presence of an anal depression is not evidence of a thin septum;

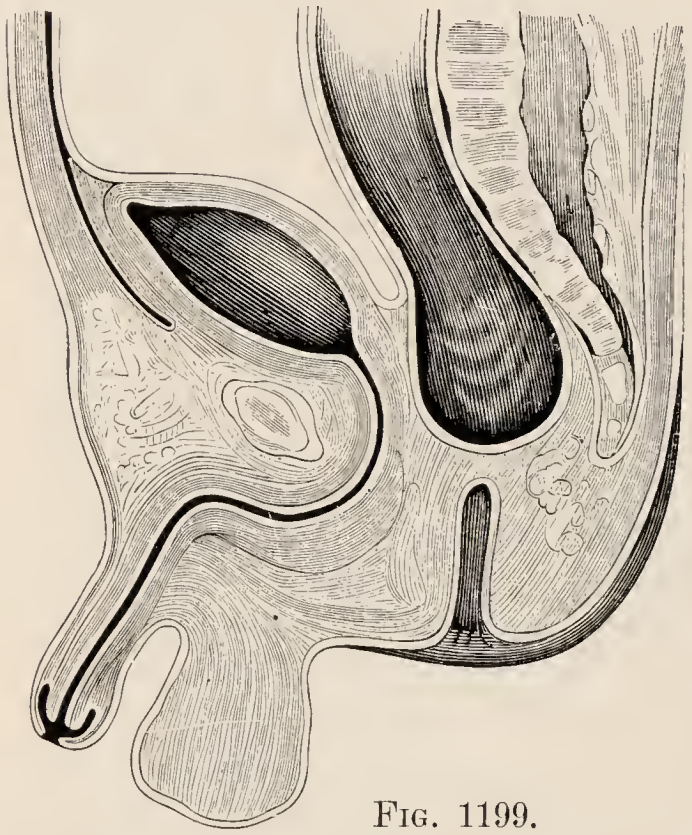


Fig. 1199.

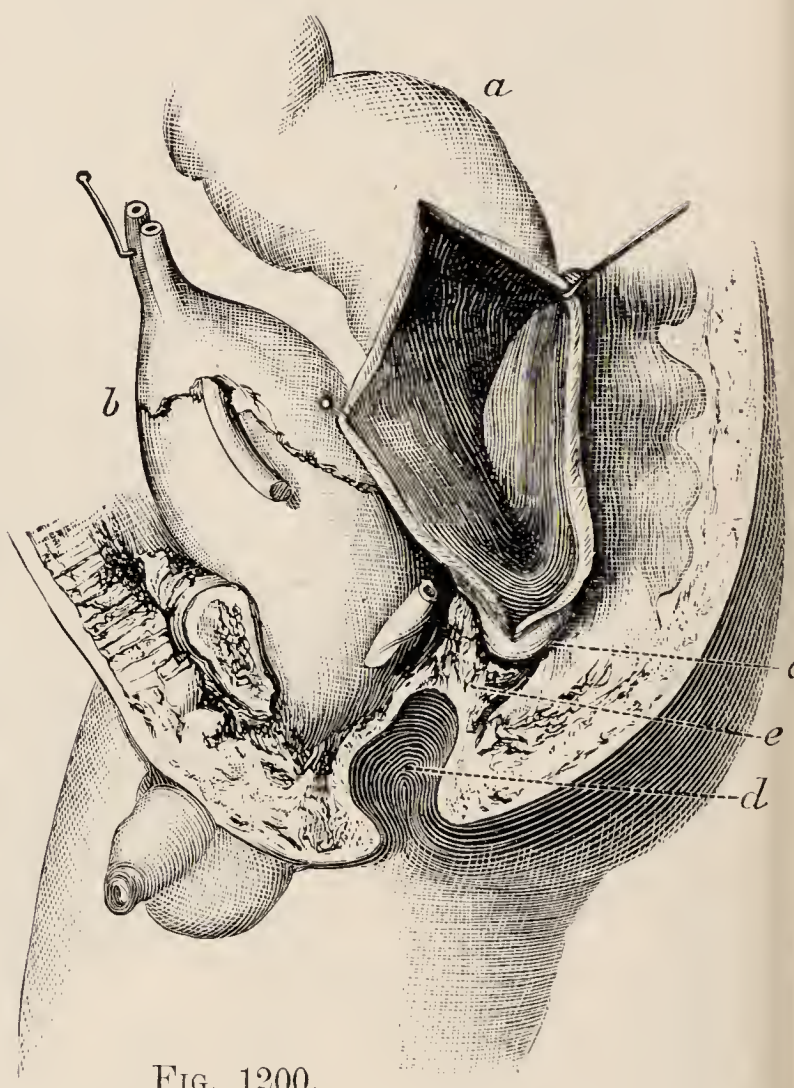



Fig. 1200.

Fig. 1199.—Imperforate rectum, with rudimentary anus.

Fig. 1200.—Imperforate rectum, anatomical relations. *a*. Upper rectum. *b*. Bladder. *c*. End of pouch. *e*. Septum. *d*. Lower rectum.

on the contrary, the reverse may be noted. The presence of a normal anus may mislead one as to the true nature of the case, therefore, a careful and extended examination should always be practiced. In some instances the rectal pouch is high in the pelvis or abdomen, when the interval between it and the perinæum is a distinct fibrous cord (Fig. 1167). Not infrequently the rectum communicates with the bladder (Fig. 1201), sometimes with the urethra (Fig. 1202), and even the glans penis (Fig. 1203), conditions which are determined by the character of the urine. Female children suffer from congenital abnormal outlets of the rectum and anal communications (Figs. 1204 and 1205). Prompt diagnosis and prompt treatment are essential to success in these cases in all instances of complete occlusion. In incomplete

occlusion, with dribbling of intestinal contents, nothing can be gained by delay, except perhaps in those cases with a vesical or urethral opening. It should be recalled that the operations are addressed in every instance to



FIG. 1201.—Absence of anus and lower part of rectum, rectum opening into bladder.

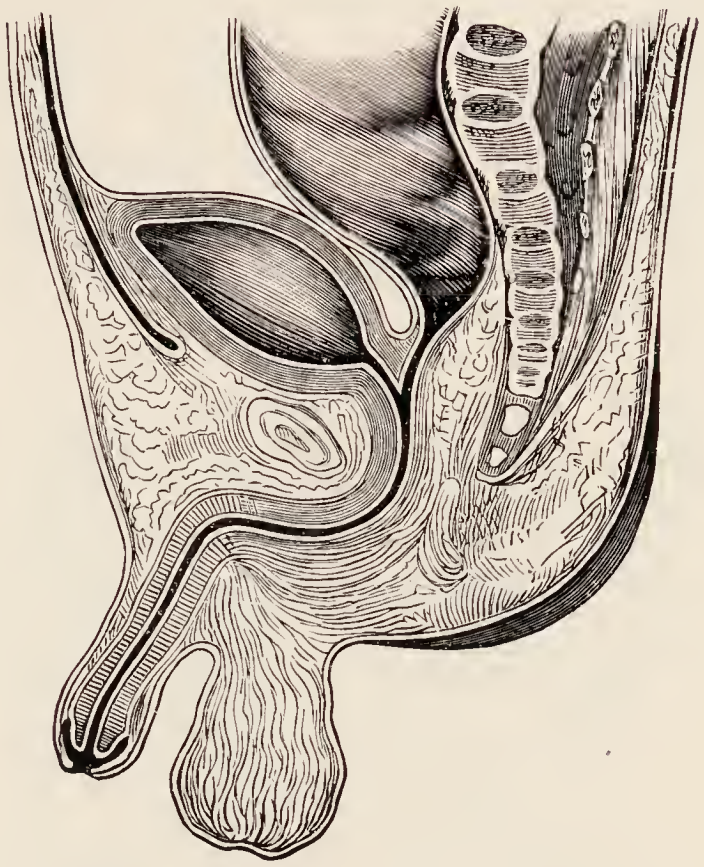


FIG. 1202.—Absence of anus and lower part of rectum, rectum opening into urethra.

infantile dimensions. The diameters between the important bony prominences which serve as guides are scarcely more than an inch in any instance.

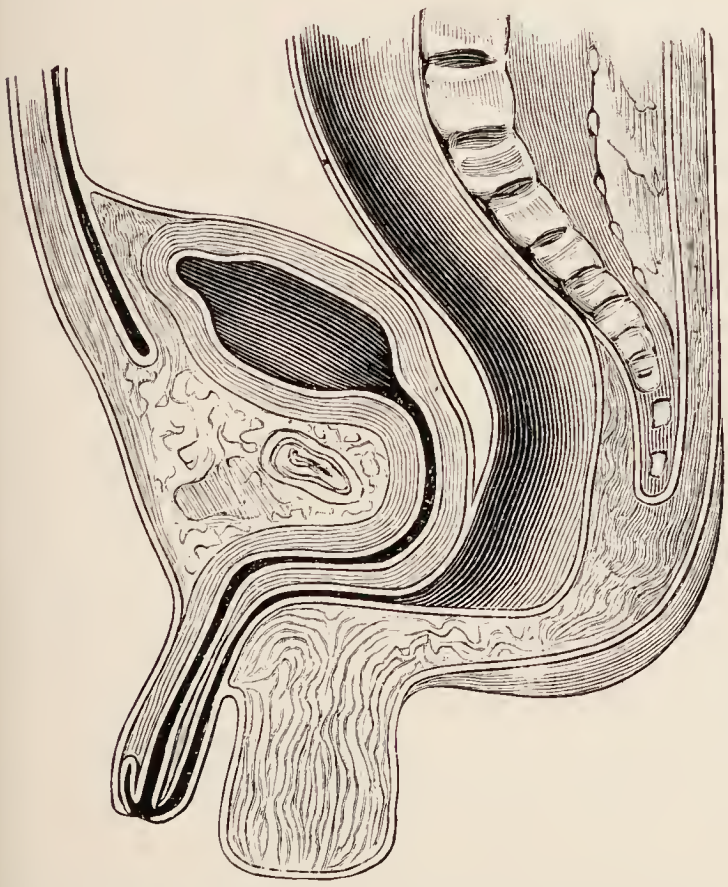


FIG. 1203.—Absence of anus, lower part of rectum communicating with glans penis.

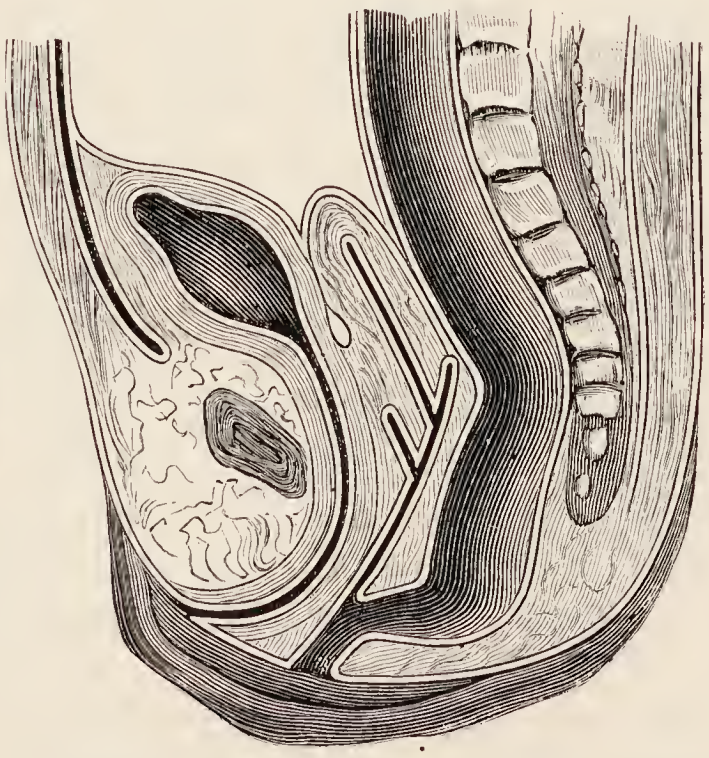


FIG. 1204.—Absence of anus, rectum opening into vagina.

*The primary indication* of treatment is to establish an artificial anus, preferably in the inguinal region.

*The Operation.*—With the patient in the exaggerated lithotomy position (Fig. 1195), introduce the finger into the rectum, note the seat and extent of the septum, and make incisions into it, radiating from the center; evacuate the contents of the gut, trim off the flaps, and maintain the opening by the occasional introduction of a well-oiled bougie. Sometimes the occlusion is so thick as to raise the question of the presence or absence of the gut above. The sigmoid flexure may terminate in a blind point, while the rectum below is marked by an impervious cord (Fig. 1167). An attempt should always be made to find the blind extremity, which is practiced by introducing a sound into the bladder and carefully seeking, by aid of the scissors and finger, for the *cul-de-sac* above. In the search the established relation which the rectum bears to the curve of the sacrum must be carefully regarded, and the fibrous trace of the rectum sought after and followed. If the abdomen of the patient be pressed upon, an existing tumor above will be made more distinct and tense. If the *cul-de-sac* be found, the diagnosis should be still further strengthened by exploring the tumor with a hypodermatic syringe or a small aspirating needle carried into its posterior aspect. The release of the fæcal accumulation is often attained quite readily by this method. However, the primary success often is quite misleading, since the time, trouble, and pain necessarily attendant on the persistent employment of bougies to maintain patency of the opening becomes so much of an infliction, as soon to be unbearable, and death ensues in a large number of cases. This plan can not be commended. If possible, the blind extremity of the gut is drawn carefully downward toward the external opening, and held in this position by forceps or by a loop of thread passed through its apex while it is opened carefully, the incision being guided by the exploring needle, which is allowed to remain for that purpose. After the contents are evacuated and the parts thoroughly cleansed, a sponge with a string (Fig. 1197 *l*) attached to it is pushed up into the bowel to prevent any further escape of fæcal matter, while the extremity of the bowel is sewed to the surface below (proctoplasty).

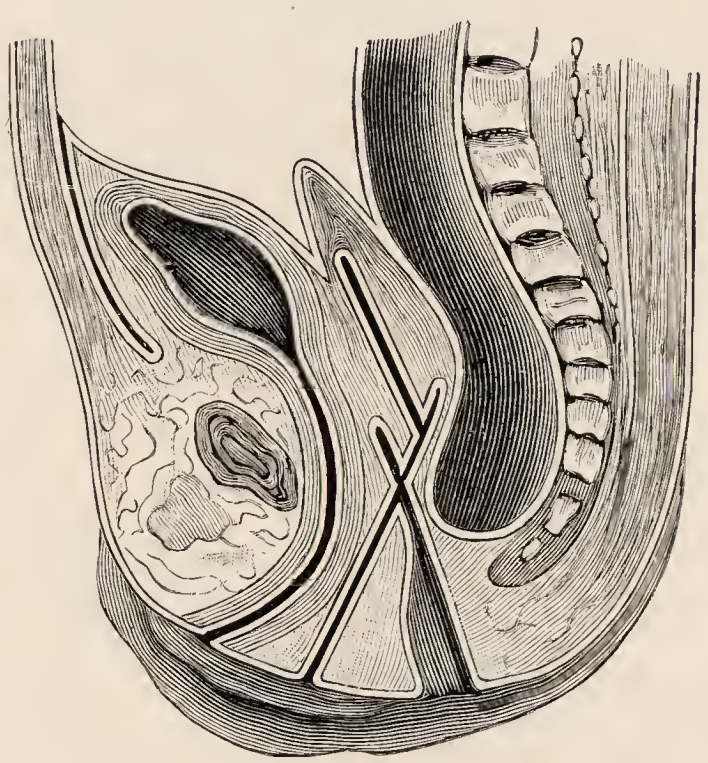


Fig. 1205.—Imperforate rectum, lower portion of rectum communicating with vagina.

**Proctoplasty.**—Proctoplasty consists in drawing down the rectal pouch, and uniting its borders to the normally located anus, or, in the event of the presence of a rectal pouch too short to be thus treated, the establishment of a new anus at the tip of the coccyx, or, as in sacral proctectomy, still higher up in this region, if need be, after removal of the coccyx or lower portion of the sacrum (page 990). When this step is impracticable, or the extremity of the bowel can not be found, colostomy (page 675) should be performed.

As the rectum sometimes communicates with the bladder, and even the glans penis or vagina, various plans of operation are practiced.

**Rizzoli's method** (recto-vaginal) of treatment of this class of cases is practiced as follows: Place the patient in the exaggerated (Fig. 1195) lithotomy position; introduce into the rectum through the abnormal vaginal orifice a sharply curved vesical sound (Fig. 1204); make an incision in the median line from the margin of the abnormal anal orifice in the vagina down to the rectum and to the tip of the coccyx; expose the rectum cautiously as far as possible by the median incision; dissect out the vaginal anus; separate the attached intermediate portions of the rectum, and transplant the vaginal anus and its connections to the posterior angle of the wound, as near to the coccyx as possible, without much traction; stitch the margin of the transplanted anus to the posterior angle of the wound; unite the borders of the vaginal wound with each other, and, lastly, also those of the perinæum. Dress the wound in the usual manner and maintain cleanliness. In the other forms of this variety of infliction the bowel should be sought for, drawn down, and the abnormal communication located and closed by sutures, if possible, and the end of the bowel stitched to the cutaneous border of the wound. This plan of action is especially serviceable in the involvement of the penis, particularly if supplemented with slitting up of the sinus. In the vesical variety, however, the outcome is dubious because of the higher situation and larger size of the opening, and the greater difficulty of securing suitable adjustment of the rectal wall. In the latter cases the bladder should be evacuated frequently to prevent distention during the healing process. Colostomy may be the only measure of substantial relief in bad vesical cases.

*The Precautions.*—The narrowness of the compass of the field of operation should be kept constantly in view to avoid the ill effects of a too vigorous or extended dissection. The use of trocars in search of the blind pouch is uncertain and often hazardous, since there is no definite assurance as to its size, situation, and relation to contiguous peritoneal surfaces; careful dissection with scissors, etc., is the safer and equally serviceable. The establishment of a fistulous opening at any point whatsoever, in the presence of the ability to create a rectum with a proper lining (proctoplasty), should not be entertained except as a brief ameliorative measure.

*The Results.*—The final results are not encouraging except in simple cases, such as those with thin septi and good reparative processes. The outcome in the various operative measures is succinctly stated by *Cripps* in a tabulated statement of a hundred cases:

| | | |
|---|---|---|
| Colon opened into the groin..... | 16 cases; | 11 died. |
| Colon opened into the loin..... | 3 " | 2 " |
| Puncture with trocar..... | 17 " | 14 " |
| Coccyx resected..... | 8 " | 5 " |
| Perineal dissection or incision..... | 39 " | 14 " |
| Complication with vagina..... | 14 " | 1 " |
| Miscellaneous ..... | 3 " | 3 " |
| | 100 " | 50 " |

Twenty-eight per cent of these cases died of peritonitis, 20 per cent directly, and 38 per cent indirectly from failure of relief.

*Anders's Series of 100 Cases.*

| | | |
|---|---|---|
| Colon opened into the groin..... | 8 cases; | 4 died. |
| Colon opened into the loin..... | 3 " | 2 " |
| Littre's operation (page 675)..... | 10 " | 5 " |
| Puncture with trocar..... | 4 " | 2 " |
| Incision ..... | 27 " | 9 " |
| Proctoplasty (dissection)..... | 44 " | 13 " |
| Non-operable ..... | 3 " | 1 " |
| Miscellaneous ..... | 1 " | 0 " |
| | 100 " | 36 " |

**Prolapsus Recti.**—The natural looseness of the submucous connective tissues, coupled with straining during defecation, predispose to prolapse of the rectum. Two varieties of prolapse are commonly recognized, *the partial* and *complete.* In the former only the mucous membrane extrudes, and the prolapse is usually but an inch or two in length and limited to the anus (Fig. 1206) (prolapsus ani), and involving sometimes the muscular tissue but not the serous covering. In the complete variety all the coats of the rectum and its peritoneal covering are involved, attended not infrequently with the descent of loops of intestine, uterine appendages, etc. (Figs. 1207 and 1208). Much discomfort and not a little suffering attends the partial variety; excruciating distress is the characteristic feature of the complete.

*The Treatment of Partial Prolapse.*—An effort should be made to remove the causes of the prolapse, when, with proper regulation of the diet and bowels, local soothing applications, and rest in bed, with the pelvis elevated for a time, a cure may be effected. At all events, much indeed will be added to the final outcome of operative procedure. The aims in the operative cure of this variety are, 1, *the production of adhesions* of the mucous membrane to the underlying tissues; 2, *the narrowing of the anal orifice* by increasing the sphincteric tone, and otherwise diminishing the anal caliber. The adhesions may be established by clamping and destroying in the long axis of the bowel isolated portions of the mucous membrane, or by removing similar portions of it by the ligature or the galvanocautery. If hæmorrhoids be present, they should be ligatured or treated with clamp and cautery, as these measures alone will often effect a cure. The application of Paquelin's cautery, longitudinally or at isolated points, to the prolapsed part, after its return, is an excellent method of procedure, and, when combined with rest in the horizontal position and the production of fluid evacuations, will often effect a speedy and satisfactory cure, especially in the young.

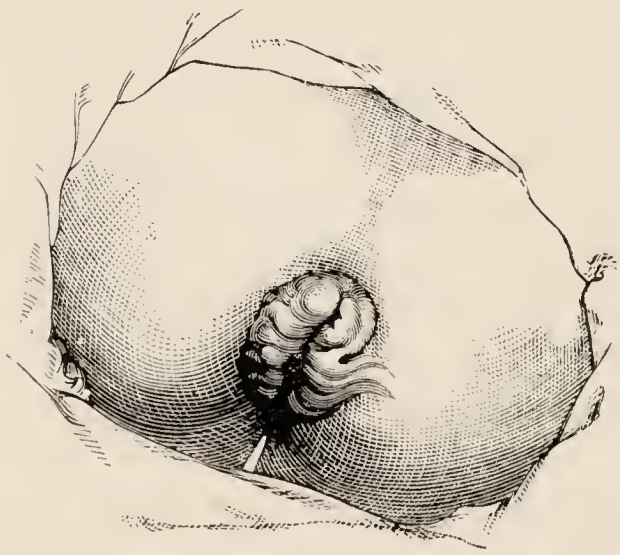


Fig. 1206.—Prolapsus ani.

**The Cauterization Method** (Van Buren).—Anæsthetize and place the patient in the knee-elbow or knee-breast position (Fig. 1086); reduce the prolapse and expose the parts with Sims's speculum. Then, with the point of a cautery (Fig. 102) at a dull-red heat, make four or five longitudinal stripes about three inches in length at equal intervals apart, terminating externally at the border of the true skin. The number, size, and depth of the eschars will depend on the age of the patient and the severity of the case. In the infant, two or three, a line or two in width, may be sufficient. The older the patient and the severer the case, the deeper should be the eschars.



Fig. 1207.—Prolapse of rectum, with invagination.

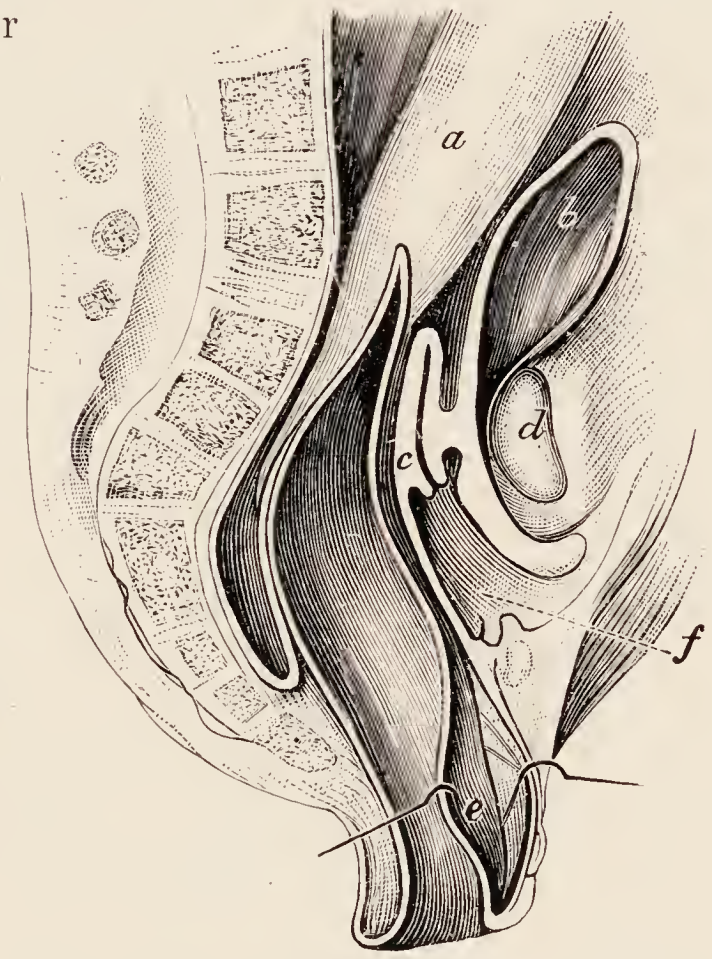



Fig. 1208.—Complete prolapse of rectum. *a*. Rectum. *b*. Bladder. *c*. Uterus. *d*. Pubes. *e*. Peritonæum. *f*. Vagina.

*The Comments.*—The eschar should be deepened as the sphincter is approached if the prolapse has been reduced; if not, extreme caution should be exercised on approaching this point, or the peritoneal pouch will be invaded. Portions of mucous membrane having obvious venous dilatations should be carefully avoided. After cauterization dust the eschars with iodoform. During recovery and some time thereafter the patient should be confined to bed and a soft stool obtained, while in the recumbent posture, every two days with a saline laxative. The cautery is often applied before the reduction of the prolapse, in order to more certainly reach the upper limit of the affliction. When this course is pursued, the reduction of the prolapse should follow immediately, to avoid strangulation of the protrusion by the sphincter.

The possibility of reanimating the sphincter after restoration is somewhat uncertain, depending of course on the degree of paralysis and the length of time of the infliction. Ofttimes seemingly hopeless cases are markedly improved. The medical expedients directed to the restoration of paralyzed muscles may be employed with some success.

The removal of isolated longitudinal strips of mucous membrane at three or four aspects of the bowel and the union of their divided borders is sometimes practiced instead in cases suitable for cauterization. However, this plan has nothing to commend it and much to disapprove of as a substitute for the cautery.

*The Treatment of Complete Prolapse.*—Complete variety of prolapse is met in three forms: 1, In which the external surface of the prolapse is devoid of a sulcus; in this the prolapse follows as the result of the continuous traction exerted by long-standing prolapse of the mucous membrane. Peritonæum is present in the tumor, and sometimes also a loop of intestine (Fig. 1208, *e*). 2, In which a sulcus occurs at the base of the tumor, at the bottom of which the mucous membrane of the gut can be felt as it is reflected from the invaginated protrusion. 3, In which the finger, when introduced into the anus beside the tumor, fails to detect any evidence of the reflection of the mucous membrane of the rectum upon the tumor; in this the invagination is extensive, involving perhaps the colon, caput coli, and sometimes the ileum itself.

Each of these varieties should first be reduced; sometimes reduction is accomplished with great difficulty and may be impossible, especially when an acute case is complicated with strangulation of the protruding portion, or a long-standing prolapse, attended with cohesions, is present.

*The Reduction of Prolapse.*—Place the patient in the knee-elbow or knee-chest (Fig. 1196) position, oil the protrusion, and carefully endeavor to return the part first that escaped last, and, if necessary for the purpose, the external sphincter can be stretched or divided. If this attempt fail, renew the effort by trying to reduce the part first that escaped first. If the manipulation be very painful, the mucous membrane of the protrusion may be painted with a solution of cocain, and even an anæsthetic may be given. To the reduction of the third variety of prolapse must be added the copious injection into the bowel of fluids (page 691) or gases, the introduction of the hand (page 966), by cœliotomy, and internal restitution and fixation.

*Cripps advises*, after treatment with caustics or cautery, that a thick rubber tube seven inches in length, with a third of an inch lumen, be passed up the rectum for about five inches. Around the mucous surface of the bowel and extending upward as "high as possible" strips of oiled lint are arranged. Finally, between the oiled lint and the tube is carefully packed cotton wool dusted with iodoform. This dressing gives a fine support to the lower part of the bowel and permits the escape of flatus. After forty-eight hours the dressing is removed and the parts are thoroughly cleansed. In a few days the tube only is employed, and this for ten days or more. He advises that the bowels be kept quiet for ten days or so with small doses of opium. He adds, further: "The patient must on no account get up or strain, and the motion is to be passed lying on the side, the anus drawn up a little from the middle line; and this should be enforced for at least six weeks, while consolidation of the eschars is taking place, otherwise the whole advantages of the operation will be lost." Should the presence of the dressing cause a rectal tenesmus not amenable to control by

moderate doses of opium, it should be lessened in bulk; failing then, removed entirely.

**Lange's Method** (*Proctorrhaphy*).—Place the patient in the knee-chest position; expose the posterior aspect of the rectum by an incision made from the lower part of the sacrum to the anus; remove the coccyx; introduce through only the muscular wall, near the median line, longitudinally a row of catgut sutures so as to fold inward the posterior wall of the bowel; introduce a second row so as to bring the lateral walls still more in apposition, thereby burying the first row; unite the divided borders of the levator ani and external sphincter with sutures; fill the cavity with gauze; close the integumentary wound, leaving room for the introduction of subsequent dressing while the deep parts heal by granulation.

*The Results.*—A severe prolapse six inches in length, of twenty years' standing, that had resisted repeated treatment by cautery and excision of the mucous membrane, was cured by this method.

**Roberts's Method** (*Elliptical Excision*) (Fig. 1209).—Prepare the patient carefully for the operation; reduce the prolapse while in the lithotomy position; make a small incision in front of the coccyx in the median line of the perinæum; introduce the finger through the incision behind the rectum and break up for three inches its posterior cellular connections; introduce a scalpel through the dilated anus half an inch to right of the median line, and make a deep incision obliquely backward and inward through the sphincter and skin to the primary incision at the end of the coccyx; repeat the incision upon the left side; remove from the entire thickness of the posterior wall of the rectum a triangular piece about three inches in length and an inch at the base, along with the perineal triangle, with scissors; ligature the bleeding points with catgut; unite the borders of the wound from above downward with chromicized catgut or sterilized silk, placing the first suture at the apex of the rectal wound; introduce successive intrarectal sutures a third of an inch apart, the last one being located just inside the margin of the anus; tie the sutures, leaving the knots within the bowel; bring together and unite the divided ends of the sphincter with a shotted wire and two catgut sutures; introduce a drainage tube between the rectum and sacrum and close the ano-coccygeal wound by shotted wire sutures "carried deeply through the structures by a strong curved perinæum needle." Quietude of the bowel is maintained in the usual manner for a few days, and is followed by an oleaginous or saline laxative.

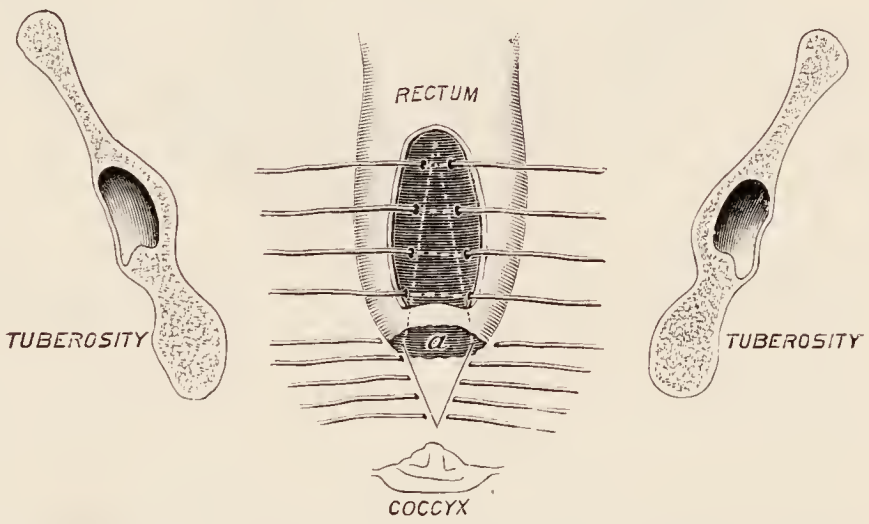



FIG. 1209.—Operation for prolapse of the rectum, Roberts's method. *a*. Anus and triangular incision of the perinæum, with sutures placed. Triangular section of posterior wall of rectum, with sutures placed for tying, seen through window in anterior wall.

*The Results.*—Inasmuch as the healing of the deep parts of the wound by granulation is essential to a cure, the recovery is somewhat protracted and the formation of a fistulous canal need not be unexpected. However, the operation is a good one, in ordinary cases having resulted in frequent and final relief.

**Mikulicz's Method** (*Amputation*).—Place the patient in the lithotomy position and thoroughly cleanse and disinfect the prolapsed portion; insert the index finger of the left hand into the prolapse and divide the external tube for about an inch parallel to and an inch from the anal margin with a knife (Fig. 1210); pass a stitch so as to unite the tubes together (Figs. 903, 905, and 906), if the space between them be unoccupied by small intestine; tie in a reef knot; leave one end short and free and use the other as a continuous quilt suture throughout the circumference of the bowel; sever the external tube as the sewing proceeds, so that cutting and sewing will cease at about the same time; cut through the internal tube and unite the divided edges of the mucous membrane with a continuous suture all round; cleanse the stump carefully and allow it to slip within the anus.

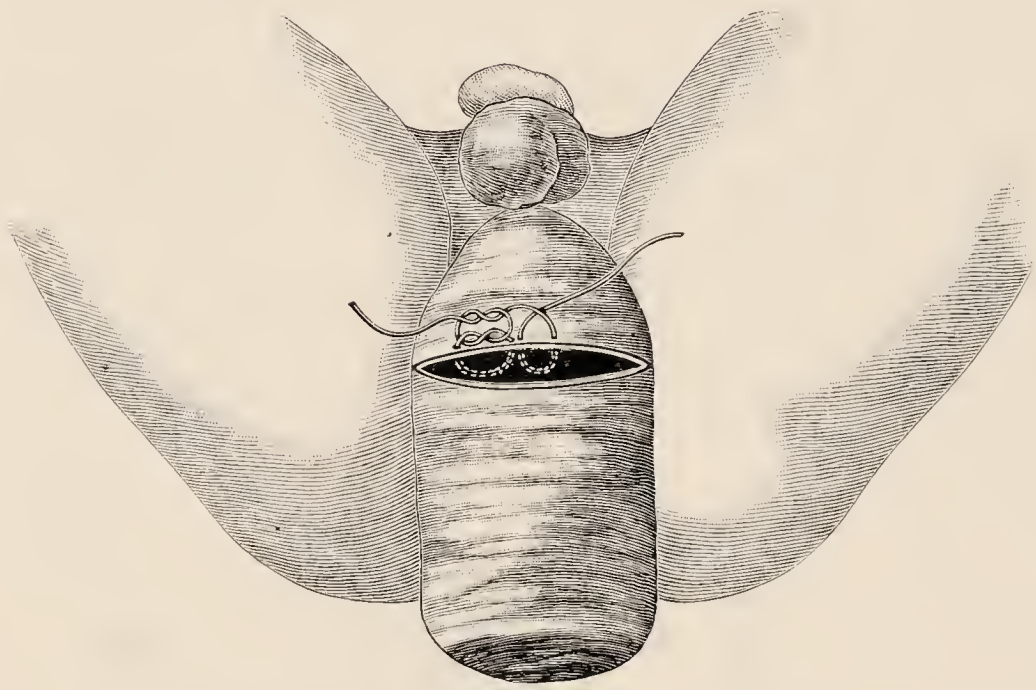


Fig. 1210.—Operation of amputation for prolapse of the rectum, Mikulicz's method. Primary sutures applied.

*The Remarks.*—The opening into the peritoneal cavity that attends this procedure bespeaks the employment of rigid asepsis. Unless care be taken, the stump will slip away as soon as the inner tube is completely divided. But little bleeding attends the operation, since it is controlled by the sewing.

**Treves's Method** (*Amputation*).—Place the patient in the lithotomy position with the pelvis well raised and draw down the prolapse to the full extent; thoroughly cleanse the field of operation; divide the mucous membrane of the outer wall of the prolapse close to the cutaneous junction, entirely round the base, with a knife; separate and turn down toward the apex of the cone the mucous cuff of the prolapse, by means of scissors and traction; cut across the anterior wall of the prolapse at the base of the cone and shut off the peritoneal cavity with a sponge; rapidly sever the remaining walls of the prolapse with scissors, seizing each inch or so of the cut end of the bowel promptly with forceps, to arrest hæmorrhage and prevent retraction of the mucous membrane; remove the sponge from the peritoneal prolongation and close the opening by uniting the borders of the divided membrane by several fine chromicized catgut sutures; unite the divided end

of the bowel to the margin of the anus by silkworm-gut sutures going through the entire thickness of the wall of the gut, and ligaturing the bleeding points as they appear; cleanse and restore the parts to the proper site.

**Kleberg's Method** (*Amputation*).—Place the patient in the lateral position, with the pelvis raised and the shoulders turned downward, on the operating table as far as possible; administer the anæsthetic; cause an assistant to grasp the prolapsus with both hands with the fingers extended downward, and press as hard as possible against the protrusion at a point just below the sphincter; pass upward, beneath the hands of the assistant, around the tumor to its base a strong rubber tube, and draw it only tight enough to arrest the circulation; fasten the tubing securely, and direct the assistant to relax his grasp; make a longitudinal incision anteriorly two inches long through the prolapsed rectum; cut the peritoneal sac at that situation; seize the elastic ligature with forceps, and prevent its displacement downward into the incision; push back into the peritoneal cavity any prolapsed small intestine; thrust a large-sized Leuer's pocket trocar from before backward immediately below the ligature through the prolapse; remove the trocar, leaving the canula behind; pass two elastic drainage tubes each a line and a half in diameter through the canula, and remove it; tie the ligatures tightly at the respective sides of the prolapse; remove the primary elastic constriction, and cut off the prolapsus an inch below the secondary ligatures with scissors; knead the parts above the ligatures with the fingers for a few moments to displace upward the fluids; protect the parts around the stump with cotton, and soak the stump below the ligature with a mild solution of chloride of zinc; dry the stump, knead the soft parts as before, and apply again the chloride of zinc; cover the whole with dry cotton batting, and cause it to be removed as soon as moist; reapply dry cotton batting, and allow the free access of air to the parts.

*The Precautions.*—The pressure of the rubber tube prevents the entrance through the incision of air or blood during the return of the intestine. Before transfixion with the trocar, be sure that the peritoneal prolongation is empty. If silk ligatures be tied around the knots of the elastic ones, these knots will be much more secure.

*The Results.*—In a patient to whom this treatment was applied by Kleberg a prolapsus a foot in length and six inches in diameter was removed. At the end of two months the patient had recovered completely. In another case a fatal result followed, due perhaps to the bad state of the patient's health.

**Verneuil's Method** (*Proctopexy*).—Put the patient in the lithotomy position and restore in place the prolapse; make outward at right angles with the antero-posterior diameter of the anus from either side of the opening an incision through the integument and external sphincter, about an inch in length; make an incision from the tip of the coccyx at each side so as to meet the terminal points of the preceding ones; dissect and raise from behind forward the triangular flap, including the subcutaneous cellular tissue and the fibers of the external sphincter, leaving them attached at the base to the tissues surrounding the anus; draw the flap strongly upward,

and loosen the posterior wall of the rectum for a distance of two to two and a half inches in width, and to a height equal to the distance from the anus to the point of the coccyx. Pass four threads parallel with each other transversely through the posterior wall of the rectum, not including the mucous membrane, placing the upper at a point corresponding with the tip of the coccyx, and the lower three fifths of an inch from the anus; pass a needle with the eye at the point, from without inward through the skin at places situated an inch and a half from the median line at either side, and withdraw the needle in turn with the corresponding end of each suture. The extremities of the upper suture should escape on a level with the sacro-coccygeal junction, and those of the lower at the tip of the coccyx. Place the remaining sutures equidistant between them; tie together at the respective sides the extremities of the first and second and third and fourth sutures over rolls of gauze placed beneath the loops to prevent their burial in the tissues from the strong traction made to secure the rectum in the new position; insert a drainage tube; replace and unite the triangular flap in its former position. The anus is narrowed by suturing the margins caused by the outward lateral incisions.

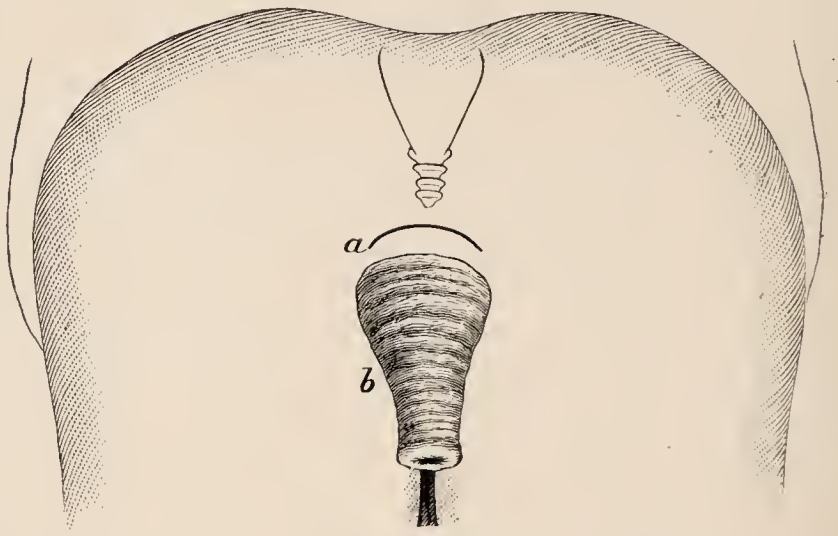



FIG. 1211.—Operation for prolapse of the rectum, Tuttle's method. *a*. Line of incision midway between apex of coccyx and base of prolapse. *b*. Prolapsed rectum.

*The Remarks.*—It is suggested that the beginning of the primary incisions should correspond to the limit in front of the amount of dilated anal tissue needed to form a new anus of suitable size.

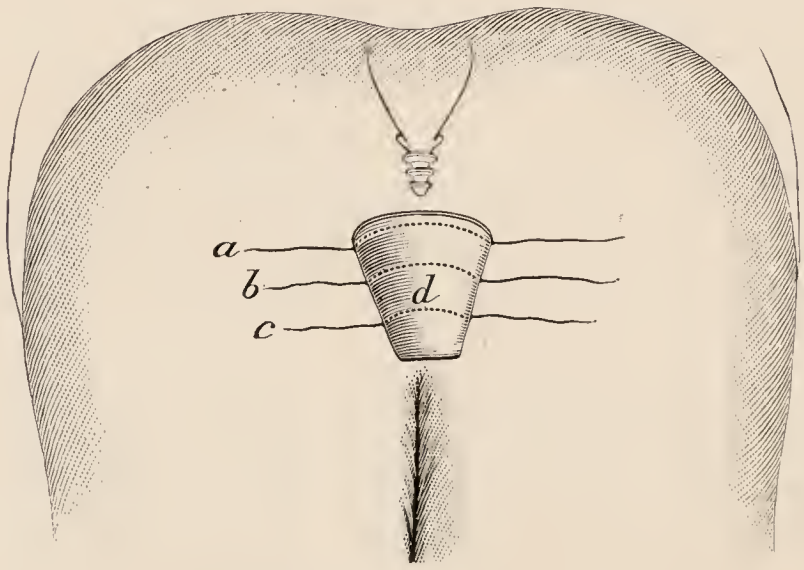



FIG. 1212.—Operation for prolapse of the rectum, Tuttle's method. Gut, *d*, invaginated through incision. *a*, *b*, *c*. Sutures passed through muscular wall of gut.

**Tuttle's Method** (*Proctopexy*).—This heretofore unpublished method is thus described by Dr. Tuttle himself: "The operation is applicable to all prolapses of the rectum, beginning below the recto-sigmoidal juncture—i. e., the first and second degrees of complete prolapse (Fig. 1211). It is based upon the fact that such prolapses are due to the relaxation or giving way of the attachments of the rectum to the sacrum and perirectal tissues, and that the rational method of cure would be to restore these attachments and hold the rectum in its normal position until they become strong enough to retain it there. Place

the patient on the side, with the hips raised. Thoroughly disinfect the rectum and external parts. A semicircular incision, about one to two inches long, is then made midway between the anus and coccyx, and extended into the cellular tissue between the rectum and sacrum. With the finger or a long, blunt-pointed, curved scissors the rectum is then separated from the sacrum, as high up as the length of the protruding gut. The sacral surface of the cavity thus made is gently curetted, to remove all fat and freshen the surfaces for future union with the gut. With the aid of an assistant's finger in the rectum, the gut is invaginated (Fig. 1212) through the semicircular incision and drawn down as far as it will come. The external surface of the posterior wall of the gut being thus exposed, is curetted and freshened down to the muscular layer. Long silkworm-gut sutures are now passed transversely through the muscular wall of the gut, taking a bight of about one inch or more each, their ends being left free. From three to five of these sutures are put in, about one-half inch apart. Then, with a long Peaslee needle, the ends of the sutures are carried up through the wound (Fig. 1213) and between the rectum and sacrum, and brought out through the ligaments, fasciæ, and skin, one end on one side of the bone and one upon the opposite side. The upper sutures in the gut are brought out, if possible, a little higher than the normal position of this portion of the rectum. When the sutures have been thus passed, they are drawn taut successively from above downwards, and tied over a fold of iodoform gauze to prevent their cutting into the skin (Fig. 1214). The rectum is thus held in its normal position by the sutures, which are left in for ten days to two weeks. A buried, circular, kangaroo-tendon ligature is passed around the rectum, on a level with the upper margin of the external sphincter, and tied tight enough to constrict the index finger passed into the anus. The operation is completed

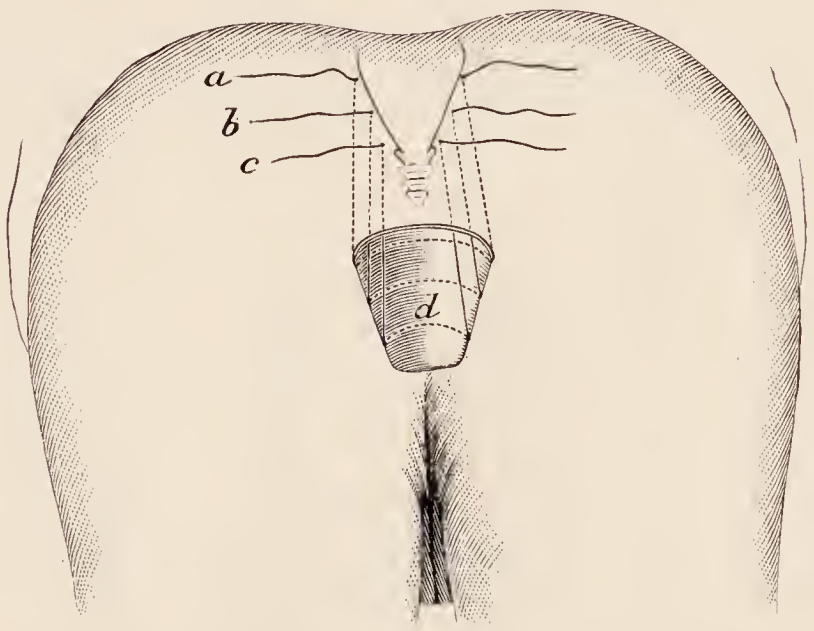



FIG. 1213.—Operation for prolapse of the rectum, Tuttle's method. Sutures passed upward and out at sides of sacrum.

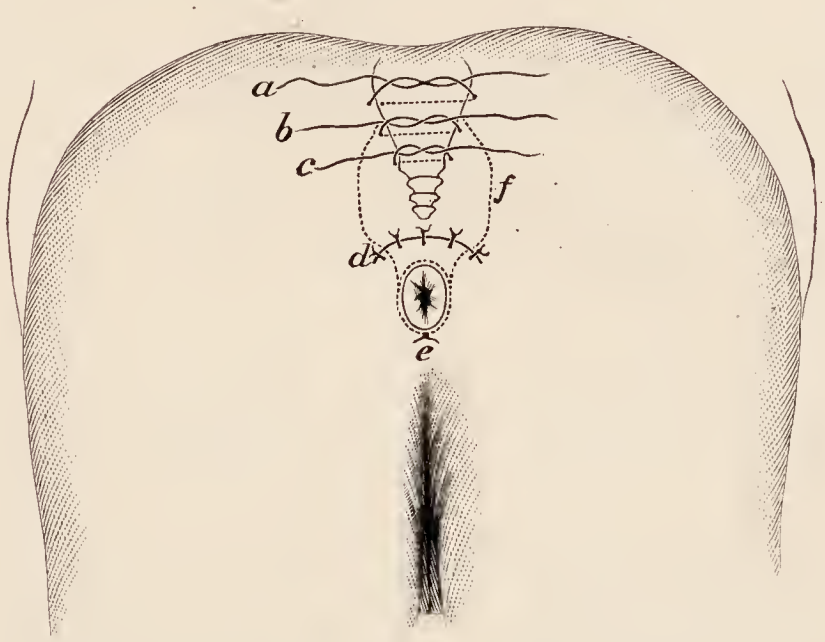



FIG. 1214.—Operation for prolapse of the rectum, Tuttle's method. *a*, *b*, *c*. Sutures tied over sacrum, gauze intervening. *d*. Original wound closed. *e*. Buried circular ligature for narrowing anus and supporting sphincter. *f*. Outline of reduced rectum.

by closing the semicircular incision posterior to the anus with chromicized gut sutures passed deep enough to bring together the ends of the recto-coccygeus and external sphincter muscles, which will have been cut. The patient is kept in bed for three weeks, and his bowels are moved by enema on the eighth day."

*The Results.*—Five cases have been operated on by Dr. Tuttle, 41, 31, 30, and 21 months ago respectively. The fifth case is of too recent date to merit attention in this connection. In four cases the average length of the prolapse and of the time of infliction was 3.75 inches and 7 years respectively. Prompt recovery and no return characterize each case.

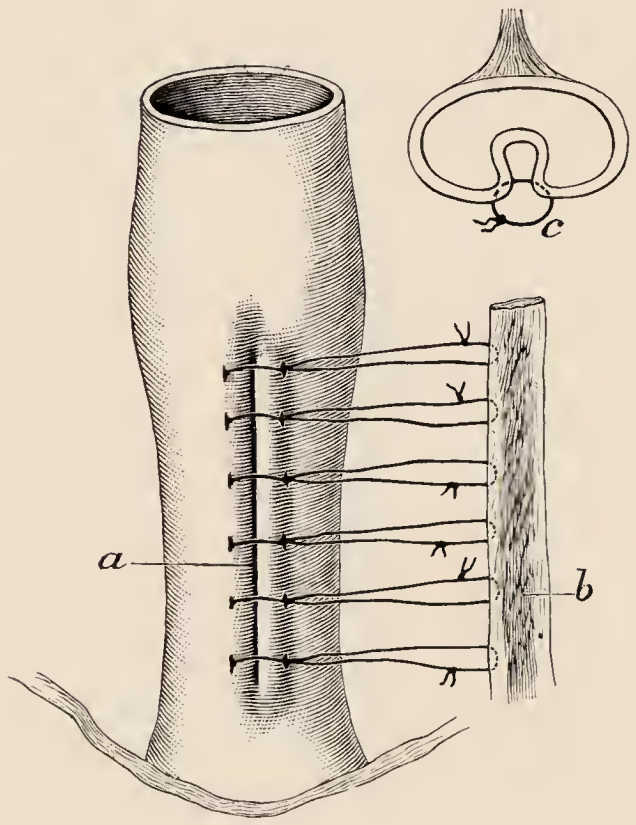



Fig. 1215.—Operation for prolapse of the rectum, Peters's method. *a* and *c*. Infolding the rectum. *b*. Abdominal wall.

**Peters's Method** (*Proctopexy*).—Peters carried into effect an operation as follows (Fig. 1215): Open the abdomen in the median line; seize and draw upward the rectum, restoring the prolapse; narrow the lumen of the lower portion of the bowel by infolding its anterior wall and confining the infold in place by six silk sutures so passed as to embrace only the serous and muscular coats (*a* and *c*). The lowest stitch should be placed as near to the anus as is possible. If now the rectum be stitched to the abdominal wall (*b*) as high up as possible by means of the long ends of the sutures, permanent restoration may be expected. A case of two years' standing without return is reported.

**Colopexy.**—Colopexy consists in the elevation and fixation of the bowel to some part of the abdominal wall for the cure of severe cases of rectal prolapse.

The operation was devised and performed first by Jaennel on February 5, 1889. He opened the abdomen in the iliac region as for the formation of artificial anus, raised the intestine out of the wound, and drew it upward so as to reduce the prolapse of the rectum. He confined the bowel in place by stitching it to the borders of the wound, and by the support of a steel sound, surrounded by gauze, carried through the mesentery, permitted it to lie on the abdomen. An artificial anus was made on the sixth day following the operation; a movement occurred on the eighth, and the sound was removed on the ninth day.*

The writer operated on a long-standing case of prolapse of the rectum that had resisted other curative measures, on October 31, 1896. At the time of the operation the prolapse was two and a half inches in length and five inches in circumference. It could be readily reduced by the patient, and remained up except with the act of defecation. The sphincter was feeble, the voluntary action being scarcely apparent.

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* Extract from a paper by the author, published in the Annals of Surgery, August, 1897.

*The Operation.*—An incision three inches in length, about an inch above and parallel with Poupart's ligament, which was made down to and through the peritonæum. The peritonæum was separated from the superimposed tissues at either side for an inch at least, but farther above than below. The gut was pulled upward firmly, causing the prolapse to disappear entirely; and, while the gut was being thus held, any relaxed tissue of the rectum within reach was drawn down. During firm traction upward on the gut the peritoneal flaps of the wound were joined to it by quilting and continuous sewing with silk, the stitches including the muscular coat of the intestine (Fig. 1216). Six silk sutures were carried through the borders of the abdominal wound so as to include the muscular coat of the gut, behind the longitudinal band. The longitudinal band was drawn forward into the wound almost to the external limit, the sutures were tied firmly, thus causing the border of the wound to grasp the entire band and a small portion of the intestinal wall. The wound healed promptly without an untoward manifestation. The patient was kept in bed for three weeks, after which he was allowed entire freedom of action in all respects. No distinct rectal protrusion appeared after defecation, or with the effort, during the two and a half years that the patient remained under observation.

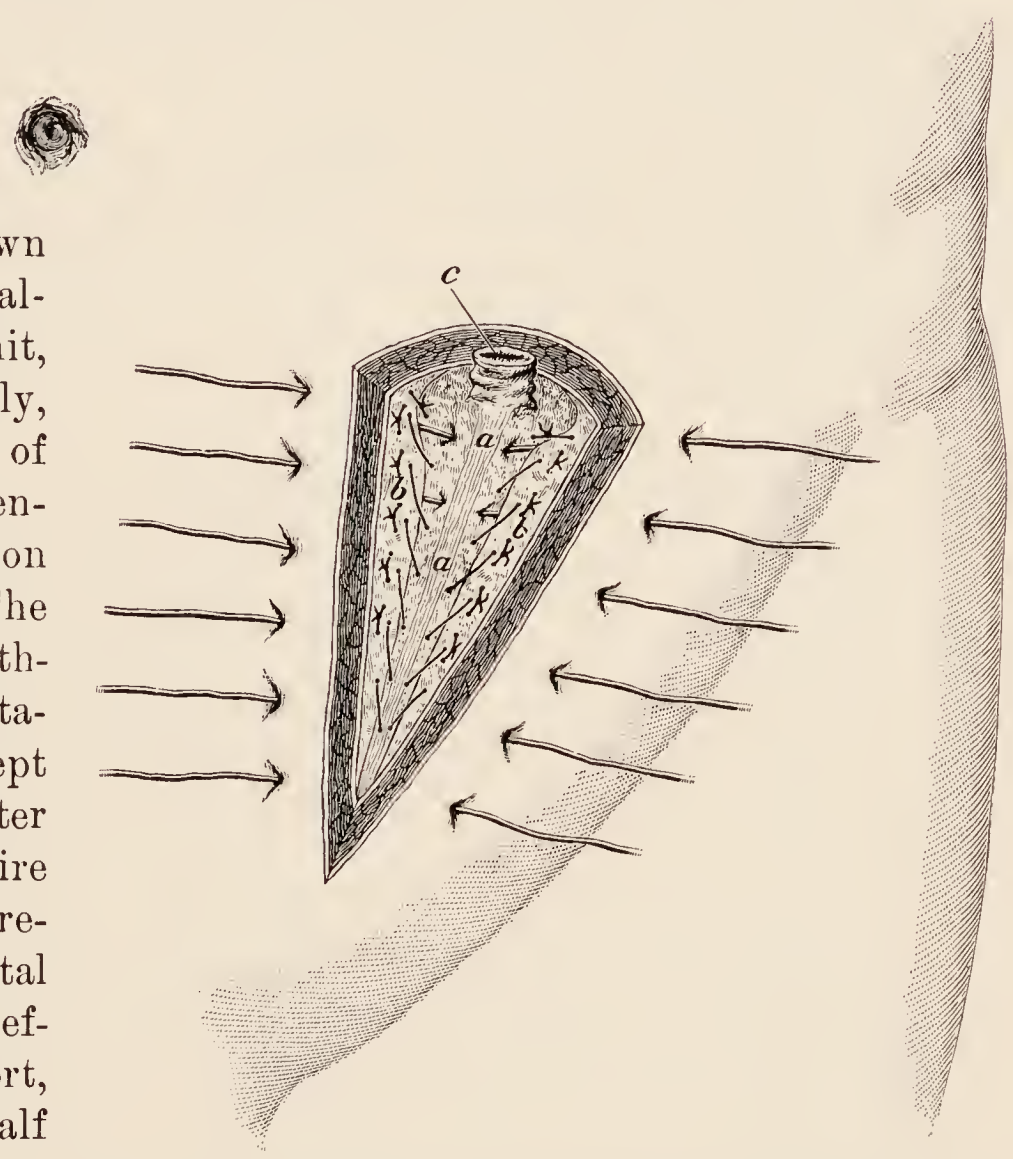



Fig. 1216.—Operation of colopexy for prolapsed rectum, author's method. *a*, *a*. Fibrous band of intestine. *b*, *b*. Parietal peritonæum quilted and sewed to intestine at either side. *c*. Old fistulous opening.

*The Results.*—In 30 cases of colopexy non-recurrence is stated in 22, partial recurrence in 3, and recurrence in 4. Not a single death, and no other sequels except a hernial protrusion in one case, is reported. No comments bearing on the facts of annoyance or suffering of any kind during convalescence are expressed.

**Introduction of Bougies, etc., to the Rectum.**—Empty and cleanse the rectum and place the patient in either one of the three positions for rectal examination (page 965); inject into the rectum an ounce or so of sterilized oil; grasp and carry the bougie (Fig. 1217) from behind forward toward the navel along the anal axis, then change the direction to backward, upward,

and to the left in accordance with the directions of the respective curves (page 963), without the use of force.

*The Remarks.*—The introduction directly upward into the anus of the tube of a syringe encroaches painfully on the superior wall of the anal curve, and the tube is often arrested by it. The intra-rectal folds not infrequently arrest the upward course of the bougie, requiring a change of direction to effect further admission. In normal conditions the bougie will pass up to near the middle of the sigmoid flexure. If this portion of the intestine or its mesentery be unusually long the end of the instrument may be felt beneath the skin in the hypochondriac region. High injections are introduced with the patient in the knee-elbow position or while lying on the side with the pelvis elevated. Rubber instruments, or those having a rubber tip, are preferable, since there is less danger of injury from their use. The employment of care without vigor in the introduction is the only assurance of safety.

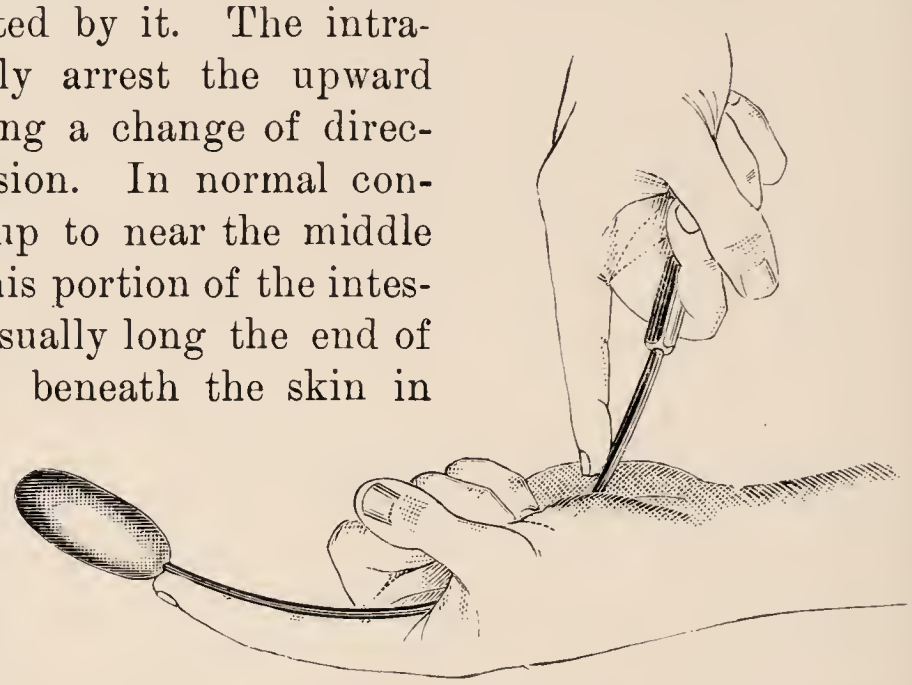


FIG. 1217.—The introduction of bulbous bougie into the rectum.

**Proctotomy.**—Proctotomy is an operation done for the relief of obstruction and constriction of the lumen of the rectum dependent on stricture from whatever cause, atresia, and for the removal of foreign bodies. Internal and external proctotomy are practiced.

**Internal Proctotomy.**—Internal proctotomy is directed to division of stricture or atresia of the rectum, and the nearer the obstruction is to the anal end of the gut the easier the division.

*The Operation.*—Cleanse the bowel, administer an anæsthetic, and place the patient in the lithotomy position; dilate the anus and expose the stricture with the aid of a speculum and light; introduce a straight probe-pointed bistoury through the stricture at the seat of most decided development, and cut carefully outward through the stricture sufficiently to reach the healthy tissues. One or more incisions are made as need be. Immediately after the cutting, fill the bowel with oiled wool or lint for twenty-four hours, then remove and introduce a vulcanite tube with a slotted collar for top attachment to hold it in position (Allingham). *Crede's* rectal bougie is useful in such cases.

*The Remarks.*—The vulcanite tube is worn more or less continuously, except at defecation, so long as there is a tendency to contraction. Complete division of the stricture at three or four points, without too great involvement of the healthy tissue, requires exceeding caution in order not to penetrate the bowel or expose too extensively the divided healthy tissues to the danger of infection.

**Bacon's Method.**—*Bacon* came to the conclusion that the only rational method of curing troublesome strictures located above the levator ani was

"by forming a new channel around the stricture by folding the gut immediately above the constricted portion down over the stricture and anastomosing it with the rectum below the narrowed part." Following this the septum was clamped away leaving a capacious channel.

*The Operation.*—Place the patient in Trendelenburg's position and make an incision in the median line from the pubes to the umbilicus; pull apart the borders of the wound, freely exposing the rectum and sigmoid flexure (Fig. 1218); locate the seat and extent of the strictured part (*); estimate the proper site of anastomosis by applying the sigmoid flexure (*e*) to the rectum (*d*) below the seat of stricture; draw the sigmoid flexure up into the wound and introduce into it in the usual manner the male segment of the Murphy button; return it to the selected site for anastomosis and

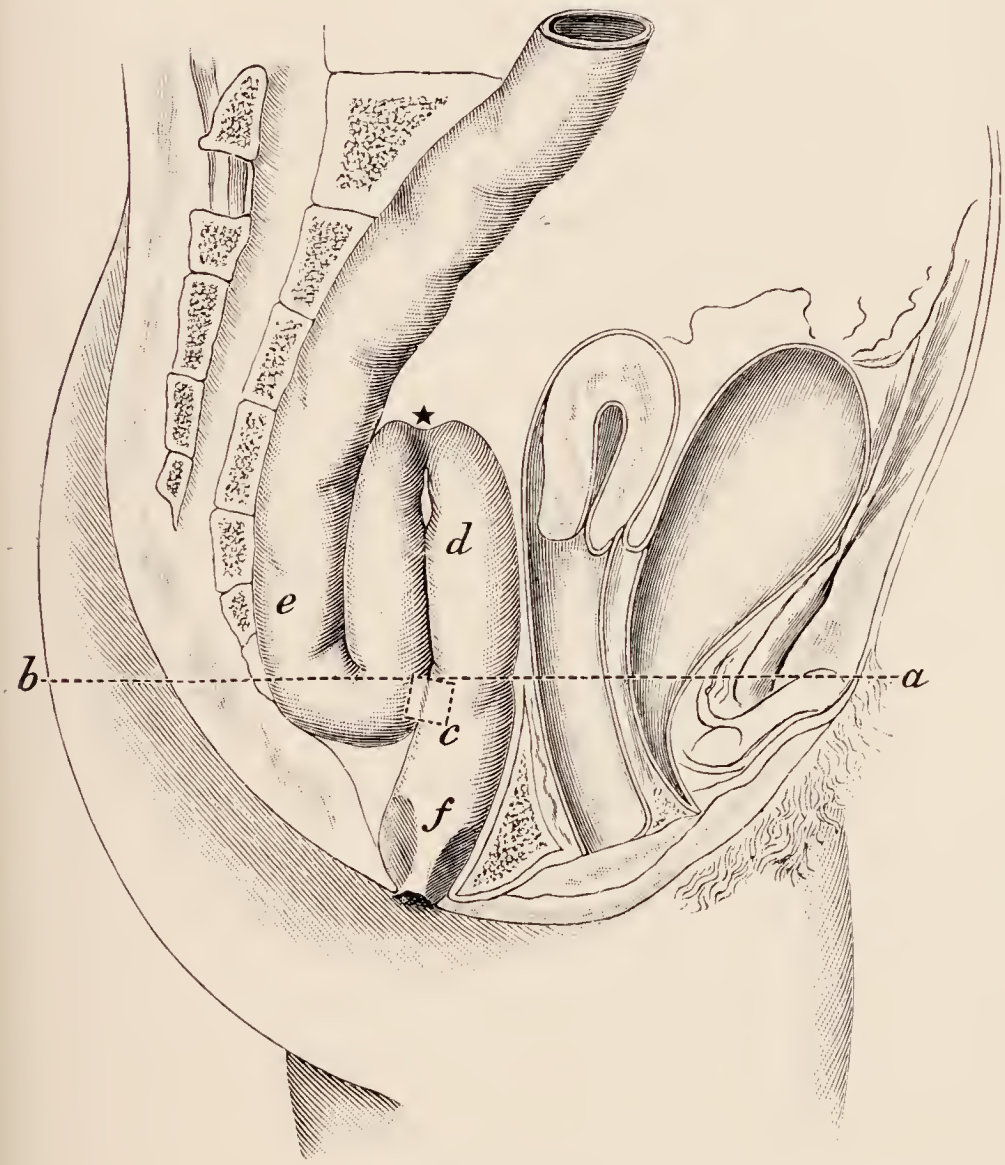



Fig. 1218.



Fig. 1219.

Fig. 1218.—Operation for stricture of the rectum, Bacon's method. *a*, *b*. Upper limit of levator ani muscle. *c*. Anastomotic opening between rectum and sigmoid flexure. *e*. Sigmoid flexure. *d*. Rectum. *f*. Anus. * Seat of stricture.

Fig. 1219.—Operation for stricture of the rectum, Bacon's method. Spiral instrument for insertion of female segment of button.

introduce the female segment of the button through the anus (*f*) up to the lower limits of the stricture by means of a special trocar-pointed instrument (Fig. 1219) so constructed as to deposit the shank of the segment in the channel caused by the perforation of the trocar; lock together the respective portions of the button in the usual manner; stitch the previously scarified

contiguous serous surfaces of the intestine closely together (*c*, *c*, Fig. 1220) to prevent the small intestine from slipping between them. After escape of the button wash out thoroughly the rectum and colon, and introduce, as indicated in the illustration (Fig. 1220), a suitable clamp, which is caused to grasp the contiguous surfaces and is tightened from day to day until the septum is destroyed and the spur removed.

*The Remarks.*—The button is usually expelled during the first week. The largest sized button is the best for the purpose. The septum is severed by the clamp at the end of the third or fourth day. Strict asepsis is demanded throughout. The special instrument for depositing the female half may be extemporized.

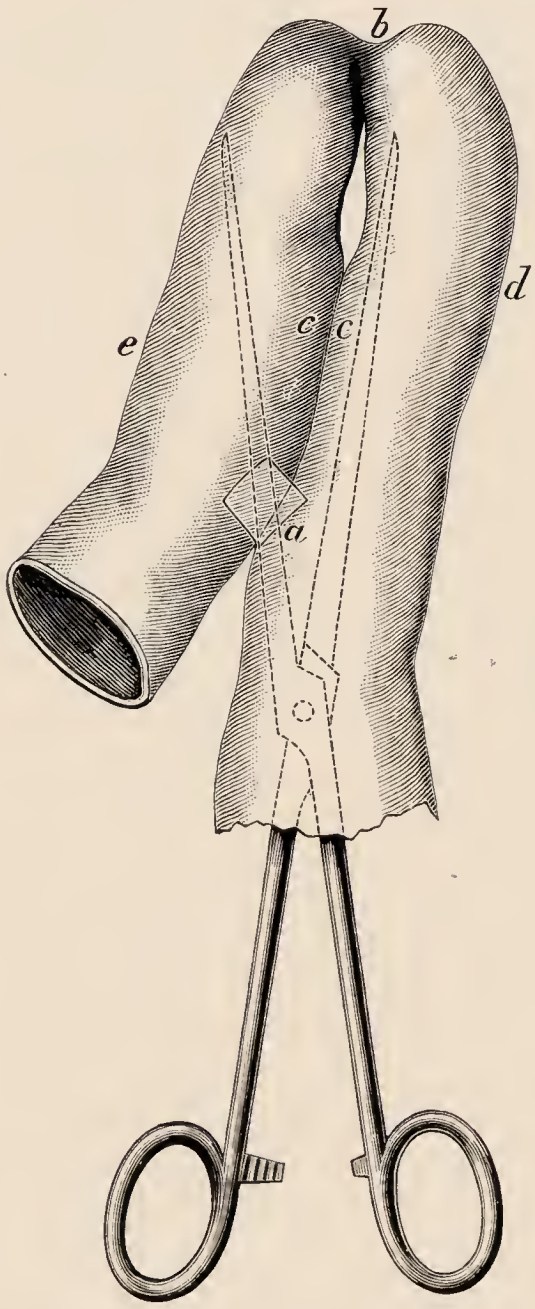



FIG. 1220.—Operation for stricture of the rectum, Bacon's method. *a*. Blade of clamp passing into sigmoid flexure through anastomotic opening. *b*. Stricture. *c*, *c*. Supplementary sutures. *d*. Rectum. *e*. Sigmoid flexure.

*The Precautions.*—If the small intestine should slip between the folds the application of the clamp will cause prompt and complete intestinal obstruction. Therefore, early and perfect apposition is sought for by means of scarification and suturing.

*The Results.*—A sufficient number of successful cures are noted to commend the method in suitable cases.

*Bacon* proposed somewhat later the following plan for the treatment of stricture located just above the internal sphincter: With the patient under anæsthesia, and the rectum thoroughly cleansed, puncture the posterior wall just above the internal sphincter with an aneurism needle armed with a heavy silk ligature (Fig. 1221); carry the point of the instrument back into the perirectal tissue behind the stricture, thence upward and through into the bowel above the upper limit of the stricture. The needle is withdrawn, leaving the ligature surrounding the stricture and with both ends hanging from the anus. The ends are tied together and the loop kept in place for "about three months" to secure a "continuous tract" (*f*), after which the suture is withdrawn, a grooved director inserted along its course, and the intervening tissue divided freely with the cautery into the rectum, thus severing the stricture.

*The Remarks.*—The idea is to establish, by means of the fistula, a tract which will remain unhealed after division of the intervening tissues, thus preventing their union and the subsequent return of the constriction.

The free drainage prevents infection and little or no annoyance attends the treatment. The patient is usually kept in bed a week after the insertion of the seton and another week after division of the stricture.

*The Results.—Bacon* reports several cases as "apparently cured" and three as "partial failures." He accounts for the latter because of failure to include with the ligature all of the scar tissue above and below the constriction. The real merits of this plan consist in the simplicity and the avoidance of division of the sphincter and its consequent annoyances.

*Hartmann* advocated for treatment of difficult stricture dilatation of the anus, the seizing, pulling down, and isolation of the stricture, followed by section of the rectum and union of the superior extremity to the integumentary border.

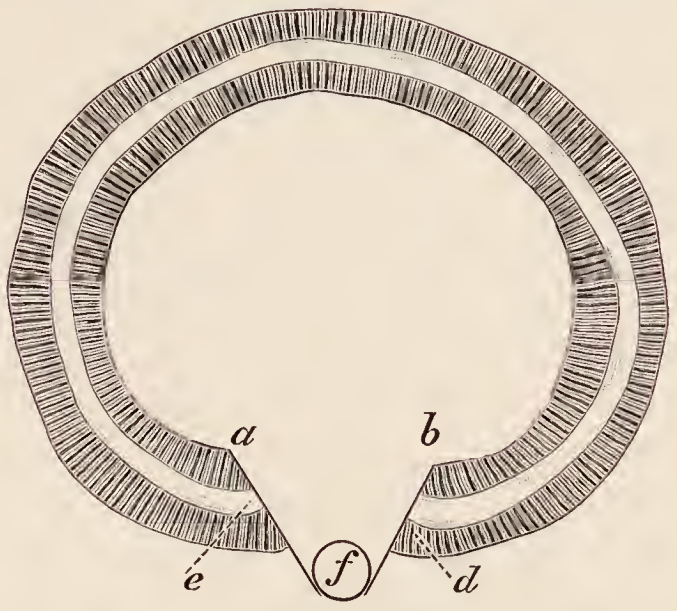



FIG. 1221.—Operation for low stricture of the rectum, Bacon's method. *a*, *b*. Separation of wall of gut (*e*, *d*) after incision through "continuous tract" (*f*).

However, it appears that at the end of a few days the stitches cut out and the upper end ascends somewhat, but not sufficiently to materially affect the results. A tube surrounded with iodoform gauze should be introduced and kept in place by gauze and a perineal bandage.

*The Remarks.—Hartmann* highly commended this plan because of its rapidity, simplicity, and the slight injury it causes. We are not disposed to regard it in the same light, except, perhaps, when the stricture is so close to the anus as to render the division of serous membrane impossible, and, too, when the accepted retraction is not followed by subsequent stricture formation.

**External Proctotomy** (*Linear or Posterior Proctotomy*).—In external proctotomy the rectum is opened from behind for the removal of foreign bodies and tumors, and for the division of malignant stricture.

*The Operation.*—Prepare and place the patient as before; open the bowel completely, from and including the anus upward and backward even to the coccyx, with the écraseur, galvano-cautery, or the knife. The knife is employed most frequently, and in either of the following manners:

*a.* Expose the lower part of the stricture by cutting through the tissues behind and below the stricture with an ordinary scalpel, and then divide the stricture completely.

*b.* Pass through the stricture a sharp-pointed curved bistoury or ordinary scalpel; turn the edge backward at the median line posteriorly and cut directly through to the external wound. Ligature the bleeding points; pack the wound firmly with iodoform gauze to check oozing and prevent infection. The wound is dressed as often as cleanliness requires.

*The Remarks.*—The division can be made from without inward with almost equal facility. Posterior proctotomy provides ample drainage and a full opportunity to secure cleanliness, both of which are denied by incomplete internal incision.

*The Results.*—The death rate from this practice is not insignificant, and thereafter the duration of life is about 100 days. Whenever the disease can

be removed and equal comfort assured by other means proctotomy should not be practiced.

**Proctectomy.**—Proctectomy signifies partial or complete removal of the rectum, and as a curative or palliative measure is, at the present time, a generally accepted surgical procedure. It can be stated as a conservative precept, however, that if the upper limit of the growth can not be easily reached with the index finger, its removal should be contemplated more seriously, owing to the contiguity of the peritonæum. Still, even under these circumstances, if the mucous membrane only be involved, the diseased structure can sometimes be stripped off without entering the peritoneal cavity. If contiguous viscera be involved, or the pelvic lymphatic glands be enlarged, the expediency of the operation is decidedly questionable. The presence of ulceration, stricture, or cancer may call for the operation. When done through the *perinæum*, through the *sacrum*, or through the *vagina*, it is called *perineal*, *sacral*, or *vaginal proctectomy*, respectively.

*The Preparation of the Patient.*—Inasmuch as the preparation of the patient is substantially alike in each method of operation, a single statement will suffice. The bowels should be cleared out two or three days, and again the night, before the operation. The external parts should be thoroughly shaved, scrubbed, and purified, the bladder emptied, and the rectum cleansed. The diet should be light and absorbable for some days before. *A rigid course* of preparation can be practiced, as the giving of a dose of castor oil daily for four or five days before the operation; a diet limited to sterilized milk, and the administration of a half drachm each of naphthol and salicylate of magnesia, thereby rendering the stools odorless and innocuous (*Routier*). The mucous membrane of the bowel should be made aseptic, and the lumen above closed with a sponge with a string attachment. The rate of recovery from the operation is regarded by some to be in direct proportion to the degree of cleanliness exercised in the preparation and during the operation. *Preliminary* colostomy in large and extensive growths and otherwise severe cases is advisable. Better asepsis is thus secured.

**Perineal Proctectomy** (*Allingham*).—Although somewhat of a misnomer, the expression perineal proctectomy serves well to distinguish this line of approach from that of either of those more definitely indicated.

*The Operation.*—Place the patient in the lithotomy position; make an oval incision between the external and internal sphincters, if practicable around the bowel, passing into both ischio-rectal fossæ; prolong the incision backward to the coccyx (Fig. 1222), and separate the bowel at the sides and posteriorly as high as the levator ani by blunt dissection; support the bowel during dissection by means of the finger within the rectum and the thumb without, carefully observing that no encroachment be made on contiguous passages (Fig. 1223); introduce through the anus, guided by the finger, a sharp-pointed bistoury, and transfix the bowel posteriorly opposite the tip of the coccyx; lay open in the median line the posterior part of the bowel; arrest hæmorrhage, and introduce long traction sutures at either side of the wound, and draw the borders widely apart; carry an incision round the anus at the muco-cutaneous junction if the anus is to be preserved; if

not, begin behind at the vertical wound in each instance, and carry the incision through the skin external to the anus sufficiently far to permit a complete removal of the disease, cutting freely into the ischio-rectal fossæ at either side; free the lateral and posterior parts of the rectum by blunt dissection with the fingers and blunt scissors, snipping the fibers of the levator ani; introduce a sound into the urethra of the male, the finger into the vagina of the female, to guide the separation of the anus and tissues in front and preserve the integrity of important structures; seize the lower end of the rectum with forceps, and draw downward and from side to side as required to facilitate the continued separation of the bowel; free the rectum all round to well above the limits of the disease; sever the rectum transversely in sections with scissors, closing the bleeding points as they arise with pressure forceps, through which means control of the proximal end of the gut is also maintained; syringe and dry out the wound cavity; ligature vessels and check oozing; draw the mucous membrane down and stitch it to the border of the integument if practicable; if not, stitch it to other tissues, all low down as feasible, and irrigate, dry and dust the raw surface with iodoform; introduce a large-sized rubber tube into the bowel, and pack around it iodoform gauze; allay pain and irritation with opium for a few days, maintaining cleanliness; after two weeks introduce daily, for a month, a full-sized rectal bougie; allow it to remain for some hours; at each introduction pass thereafter daily for a year or more, or so long as contraction is present, the rectal bougie.

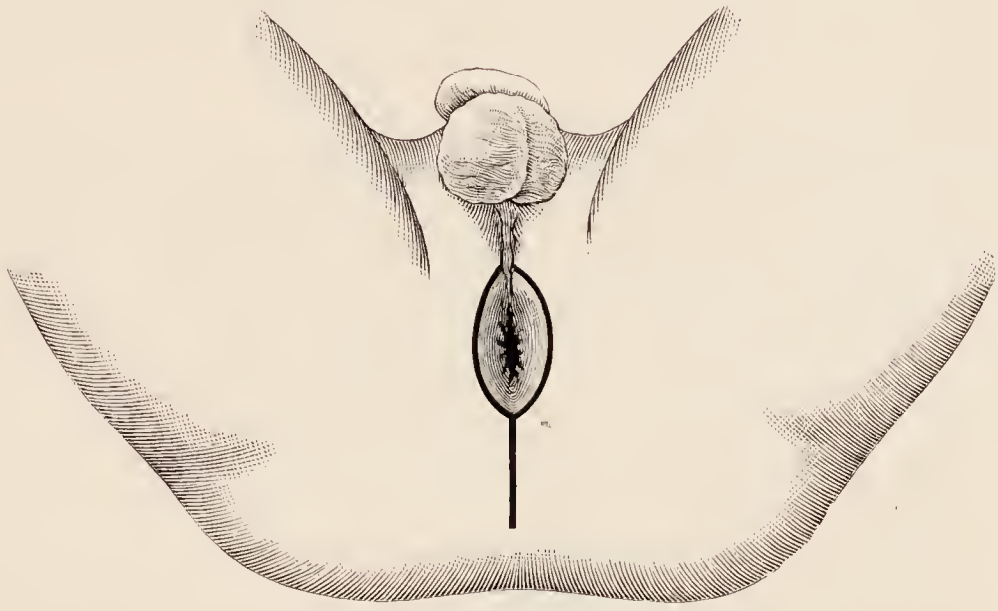


Fig. 1222.—The operation of perineal proctectomy, Allingham's method. Line of incision.

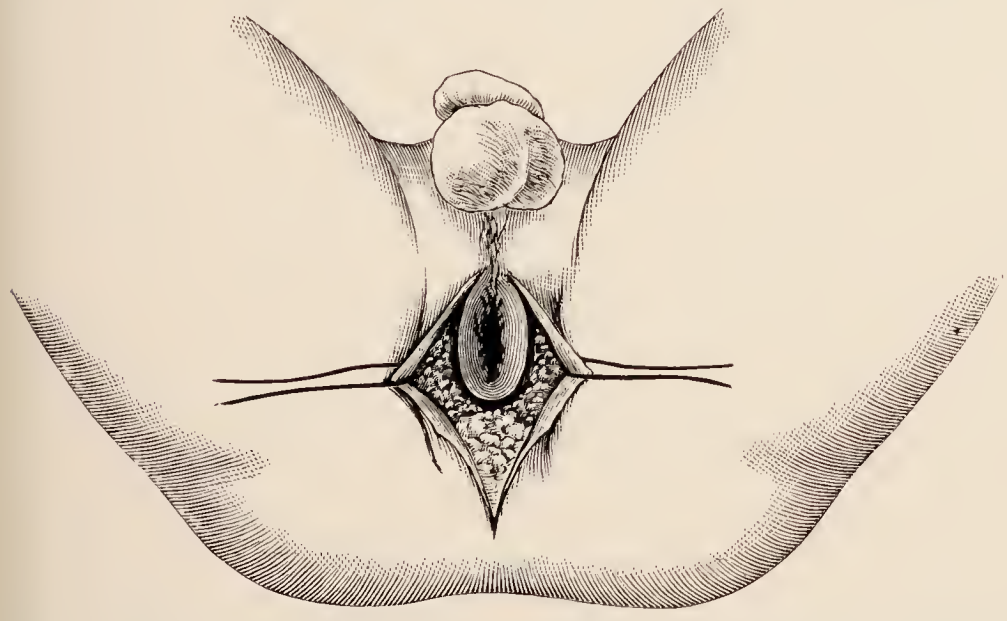


Fig. 1223.—The operation of perineal proctectomy, Allingham's method.

*The Precautions.*—Carefully avoid injury of the vagina in the female, and of the urethra in the male; notice if the peritoneal cavity has been

opened, and if so, repair it by sewing, if possible, otherwise introduce a gauze tampon; with care, little danger from this involvement need be feared. The strong tendency of the opening to close should be observed and actively combated in all instances. Retention of urine is likely to follow the operation. All diseased tissues should be removed if practicable, otherwise the operation will be of but little use and possibly do much harm.

*The Remarks.*—The needless sacrifice of any part of the rectum or anal margin should be avoided for obvious reasons. When the growth approaches the posterior wall the posterior median incision should be made, but with a due regard for the presence of the superior hæmorrhoidal artery. If the disease be high a full bladder often facilitates the operation by raising the recto-vesical pouch. A malignant growth within the rectum of the male should be located not higher than four inches from the anus, and in the female not higher than three inches anteriorly, for the purposes of efficient removal by the perineal route. The prostate body and contiguous tissues are slowly invaded, but the vagina and uterus are quite promptly involved by malignant extension from the rectum. The suturing of the end of the divided gut to the tissues below hastens healing, lessens the area of exposed raw surface, and diminishes the tendency to stricture. If infection happens above the line of sewing, drainage and cleanliness should be secured, aided by removal of one or more and perhaps all of the sutures. Sutures thus employed should be carried deeply and caused to eliminate as much as possible the presence of dead spaces.

*The Results.*—The general death rate of the operation is 18 per cent, and about 15 per cent are cured (Wendel). Special operators show an improved result in each respect.

**Sacral Proctectomy.**—Sacral proctectomy is a procedure devised for the purpose of high removal of the rectum in cases not amenable to operation by other routes. For briefness and lucidity of description the operation is divided into three stages: 1, exposure of the rectum; 2, removal of the diseased portion; 3, the securement of the upper segment. The first stage especially is variously altered by different operators, all of which changes are, however, but modifications of the original conceptions of Kraske.

**Kraske's Operation.**—Administer an anæsthetic, and place the patient on the right side; make an incision in the median line from the center of the sacrum to the anus through the soft parts; detach the ligamentous and fibrous tissues from the left side of the coccyx and the sacrum as high as the third sacral foramen; disarticulate and remove the coccyx, and with a gouge remove the lower part of the left side of the sacrum in a curved outline (Fig. 1224) to a level with the lower border of the third sacral foramen; free the posterior wall of the gut from the connective tissue and muscles, and place the patient in the exaggerated lithotomy position; sever the anterior connections of the bowel; isolate carefully the parts to be removed with gauze to prevent infection; remove the diseased segment by transverse division of the gut at a distance of half an inch or so at either side of the growth; draw the bowel down from above, and join it in the usual manner

to the lower segment by sewing; establish proper drainage, and prevent peritoneal infection by careful attention.

The preceding description is an abbreviated statement of Kraske's pioneer operations, which, while retaining merit, have yielded to the modifying influences of improved technique. The incision for exposure of the bowel made by Kraske has been modified by various surgeons for conservative purposes and to gain additional room. *Hochenegg* and *Badenhauer*, *Levy*, *Rydygier* (Fig. 1224), and others removed an additional amount of the sacrum.

*Heinecke* made an incision through the sphincter along the middle line to the tip of the coccyx, thus exposing and dealing promptly with the first part of the rectum. He then extended the incision along the median line of the sacrum to the third spine of that bone, and divided the bone in the course of the incision to a point corresponding to the lower level of the third sacral foramen. At this point right-angled incisions were made at either side through the soft and hard parts, and the triangular flaps thus formed were turned outward, causing free exposure of the rectum.

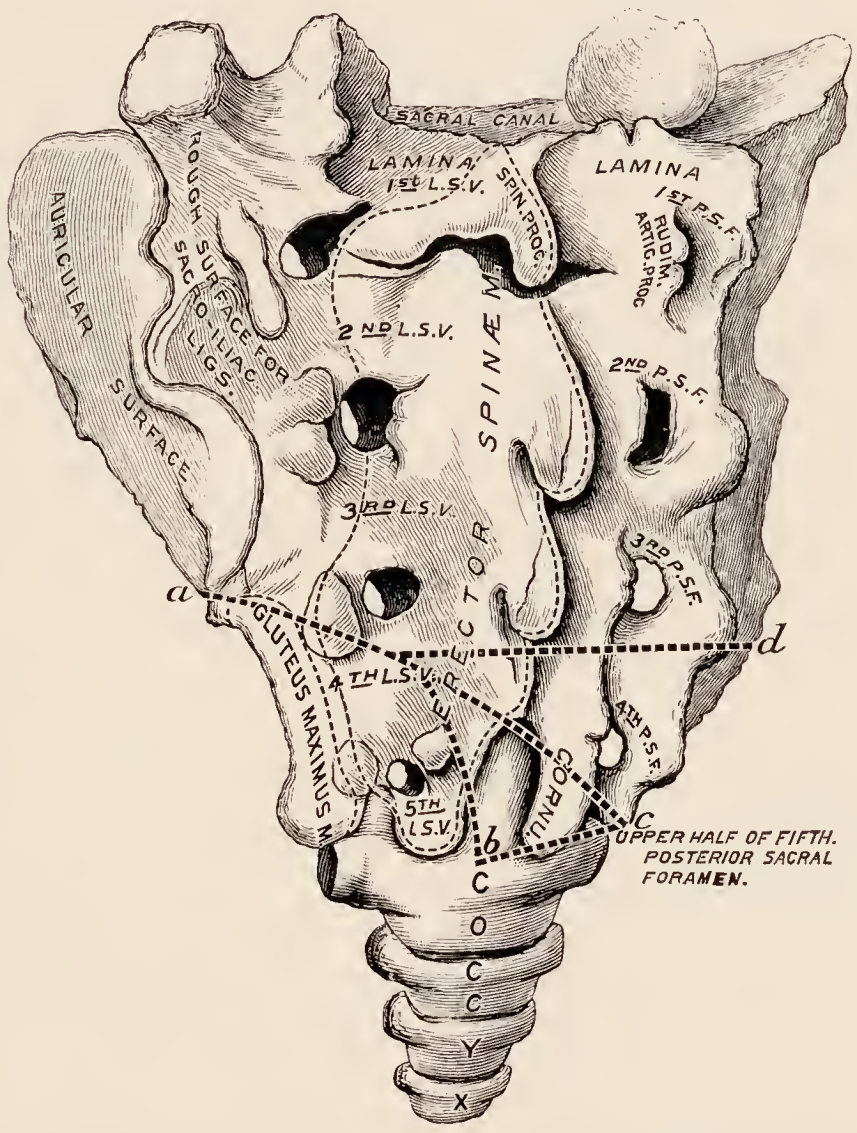



FIG. 1224.—The operation of sacral proctectomy, exposure of the rectum. *a*, *b*, *c*. Kraske's lines of division of the sacrum. *a*, *c*. Hochenegg's line of division. *a*, *d*. Badenhauer's, Levy's, and Rydygier's lines of division.

**Kocher's Method of Exposure of the Rectum.**—*Kocher* exposes the rectum at the left of the gluteal cleft from a point two fingers' breadths below the posterior superior iliac spine downward to and along the median line of the sacrum, coccyx, and ischio-rectal region to the posterior edge of the anus, which opening it surrounds, terminating at the rhaphe in front.

*If bone is to be resected*, expose the edge of the sacrum by separation from the bone of the corresponding part of the gluteus maximus; divide the ligaments and muscles attached to the border, and separate the bone from the deeper tissues; remove respectively the coccyx, the lower part of the sacrum, or a small portion of it, or a piece extending up to the fourth, the third, or even to the second sacral foramen, as may be needed to properly expose the bowel. The coccyx is removed by means of traction made by a sharp hook applied to its apex during its disarticulation; the lower part of the sacrum by chisel and mallet. Active bleeding at this time comes from

the divided bone, and the middle and lateral sacral arteries. The arteries lie so closely to the sacrum that ligature is difficult, and plugging may be required to arrest bleeding. The inferior hæmorrhoidal vessels suffer with division of the sphincter and the tissues associated with the anal end of the rectum.

*If bone is not to be resected*, detach the greater and lesser sacro-sciatic ligaments from the edge of the sacrum and both edges of the coccyx; divide the pyriformis, the coccygeus, the levator ani below the apex of the coccyx, and the external sphincter, from above downward.

*To expose the rectum higher up*, separate its connections from the sacrum and the coccygeal muscles and ligaments; divide the peritonæum at either side of the gut at the posterior wall of Douglas's *cul-de-sac;* ligature branches of the middle and superior hæmorrhoidal arteries during higher separation of the rectum; divide the presacral fascia; draw down the rectum with a blunt hook after division of this fascia, and ligature the lateral and posterior vessels; divide the prerectal fascia, thus exposing the prostate, vesiculæ seminales, lower ends of the vasa deferentia, the base of the bladder, and the lower end of the ureter a little to the outer side and upper end of the vesiculæ seminales.

*In movable carcinoma of the rectum within the reach of the finger*, divide the integument, subcutaneous tissue, and muscular fibers from the anus to the sacrum; free the rectum laterally by passing the finger along either side of the gut, hooking up and cutting between ligatures the vascular bands encountered; grasp the rectum above the anus and pull downward upon it, increasing the displacement by division of its sacral connections; draw the growth downward and outward, and divide the muscular coat only, an inch or an inch and a half above the growth, and ligature the vessels; tie a strong silk ligature round the gut above the point of division of the muscular coat, and divide the mucous membrane below the incision with a thermo-cautery; separate the diseased portion with the mucous membrane downward as far as the anus, and remove it, using care to prevent infection; pull down and suture the tied part of the rectum to the freshly pared muscular margin of the anus. Cleanse the lower end of the rectum and stuff it with gauze.

**Tuttle exposes the rectum** as follows: Place the patient on the left side with hips on a hard pillow in Sims's position, and with the legs well flexed; make an incision at the left side about half an inch from the margin of the sacrum, beginning at a point opposite the third sacral foramen and extending down to the tip of the coccyx; carry the incision through the sacro-coccygeal ligament into the cellular tissue behind the rectum; detach the rectum from the anterior wall of the sacrum with the fingers; make a transverse incision at the upper limit of the first incision across the sacrum down to the bone; divide the bone transversely with a chisel and turn the flap to the left, thus exposing to view the rectum. *Tuttle* lays stress upon the control of hæmorrhage by rapidly exposing the rectum and clamping it with a long-jawed forceps before attempting to dissect it out.

**Levy's Method of Exposure of the Rectum.**—Make a transverse incision across the sacrum a finger's breadth above the cornua of the coccyx (Fig.

1224) down to the bone, and extend it at either side of the coccyx in a curved direction, parallel with the fibers of the gluteus maximus to within two inches of the tuber ischii; separate the fibers of the gluteus maximus at either side and draw them apart; locate the fourth sacral foramen; expose and divide the sacro-sciatic ligaments carefully on a director in a line with the original incision down to the margin of the sacrum at either side; separate the parts in front of the sacrum along the line of the horizontal incision; introduce a chain saw and divide the bone from within outward; turn down over the anus the osteoplastic flap, thereby exposing the posterior rectal region to view. This plan is not regarded with special favor.

**Rehn-Rydygier's Method of Exposure of the Rectum.**—Make an incision from the posterior superior spine of the ilium downward, along, and half an inch from the left margin of the sacrum to the apex of the coccyx, thence along the median line to near the anus if necessary (Fig. 1225). Expose the margin of the sacrum at the upper end of the incision; locate and divide the greater and lesser sacro-sciatic ligaments; make a transverse incision across the posterior surface of the sacrum two fingers' breadth above the sacro-coccygeal articulation; raise the soft parts from the anterior surface of the sacrum below the third sacral foramen; saw or chisel through the sacrum transversely in the line of the incision; turn the osteocutaneous flap to the right, and expose the posterior rectal region. This plan is regarded with special favor.

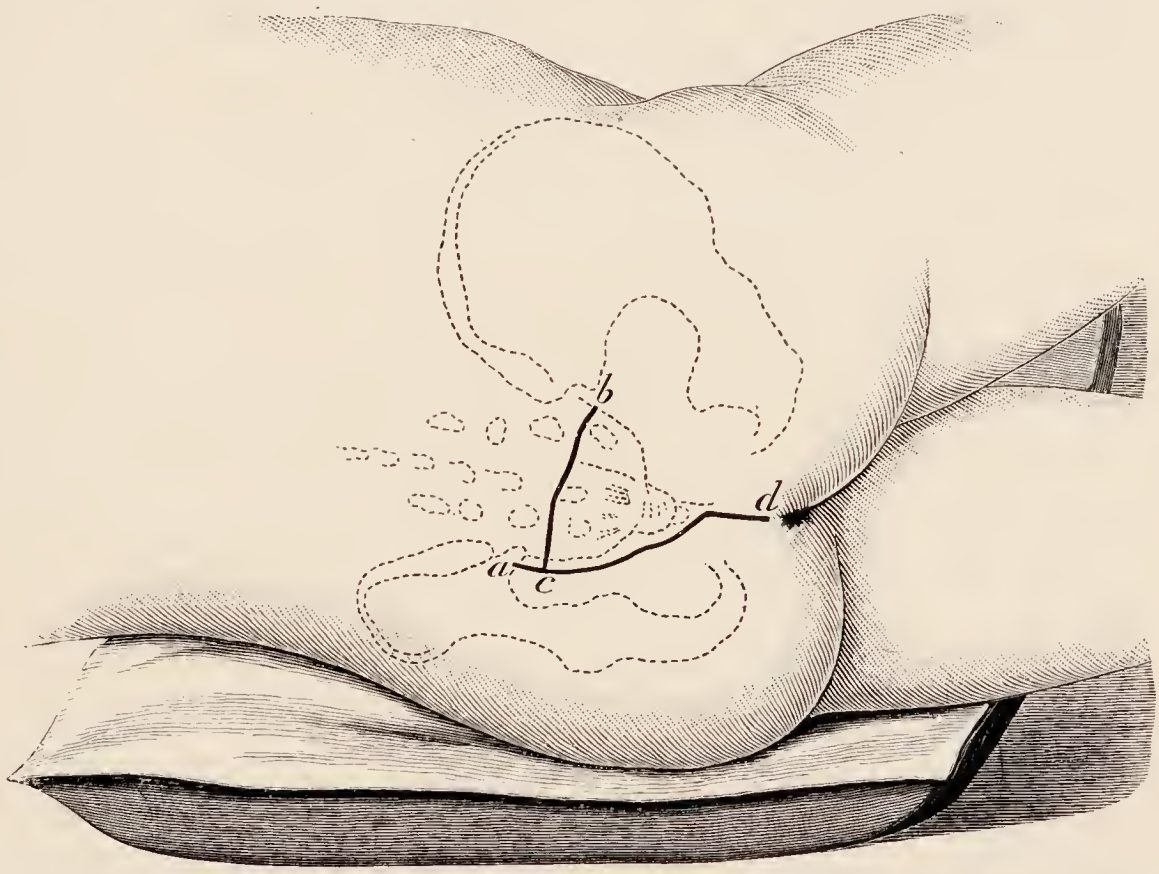



FIG. 1225.—The operation of sacral proctectomy. *a*. Posterior superior spine of ilium. *b*, *c*. Transverse incision. *c*, *d*. Incision at left border of sacrum, etc.

**Borelius's Method of Exposure of the Rectum.**—Place the patient on the right side with the knees drawn up and the pelvis raised. Make an incision in the median line from the tip of the coccyx to a little above the middle of the sacrum down to the bone; make a second incision from the beginning of the first along the lower border of the left gluteus maximus muscle; separate the flap from the sacrum and draw it aside; raise the tissues of the right border of the wound sufficiently to permit the division of the sacrum obliquely downward from left to right below the third (left) and fourth (right)

sacral foramen; free the bone flap sufficiently to permit it to be turned to the left, thus exposing to view the posterior rectal region.

*The Remarks.*—Since the third sacral nerves are concerned largely in the motor function of the rectum and bladder, it is unwise to invade the third sacral foramen needlessly, as paralysis of these viscera may result from injury to the nerves. However, Kocher states that the division of the sacrum may be extended up on *one side* as far as the second sacral foramen without permanent loss of power of the rectum and bladder, because of the integrity of the nerves of the opposite side. General practice commends the exposure of the third and fourth sacral foramen, the drawing aside of the corresponding nerves, and transverse division of the sacrum just below the third sacral foramen. An oblique section of the sacrum of proper dimensions removes in any instance the fourth sacral foramen. The division of the sacrosciatic ligaments at the border of the sacrum exposes to danger the pudic vessels and nerves. In no instance should the bone flap be replaced and fastened in position unless proper union of the divided bowel is assured. The normal support given the rectum and pelvic contents by the sacrum is not much impaired if the bone flap be restored to its normal relations with the contiguous tissues. Operations that limit the extent of the bone excision to a minimum limit likewise the opportunity of inspection and manipulation of the diseased part, which are of greater significance than is the diminished support incident to liberal resection.

*The Second Stage* (*Removal of the Diseased Portion*).—The rectum is dissociated from surrounding tissues by means of blunt dissection with the fingers, grooved director, blunt-pointed scissors, etc., attended by prompt arrest of hæmorrhage by ligature and gauze packing. If the peritoneal cavity be opened into inadvertently or otherwise, the wound is promptly closed by suture or tamponade, depending on the reason for the infliction of the injury and the presence of infecting agencies. Careful protection with gauze should be given the peritonæum and other tissues during removal of the diseased part. The limits of the disease are determined by external manipulation of the bowel, or, if need be, internal digital examination conducted through an opening made into the gut near the locality of the disease. The diseased part is removed by use of the scissors, cautery, etc. The removal of the diseased segment is followed quickly by cleansing of the wound and closure of the peritoneal openings by sewing when possible. The bringing down to the proper position for union of the upper segment, especially in high division, must be so conducted as not to impair the nutrient vessels of the mesentery and cause gangrene of the gut. *Gerster* emphasizes the importance of cautious technique in the following well-chosen words: "Where high amputation is to be performed, the surgeon must try sedulously to preserve the nutrient vessels of the mesentery, otherwise the entire rectal stump may mortify. This will be found most difficult in that part of the rectum which adjoins the flexure. Lateral incisions through the peritoneal attachments are permissible, but cutting into the mesenteric line itself will certainly be followed by disaster. Adequate lateral incisions will permit the surgeon to peel up the gut from the sacrum by the gentle use of

the finger tip. The higher this detachment of the gut is carried up, the less tension will have to be encountered in drawing down and attaching the stump to the upper angle of the external incision, especially where portions of the sacrum have been removed. A few stout silk sutures passed through the entire thickness of the gut laterally will serve amply to anchor the gut to the skin, the seat of the wound remaining open. In cases where the peritoneal cavity has been invaded, it is best to stitch up carefully the peritoneal wound as soon as possible." Incautious manipulation of the rectum, especially traction, exposes the patient to all the dangers attendant on consequent rupture. *Tuttle* emphasizes the importance of cutting the mesorectum as close to the sacrum as possible, in order to avoid wounding the superior hæmorrhoidal artery. He considers that the most important part of the technique is dissecting out and bringing down all of the intestine that is intended for removal, and closing the peritoneal cavity thoroughly by sutures or packing before opening the gut at all, thus avoiding infection of the abdominal cavity, which he regards as the greatest danger in the operation.

*The Third Stage* (*Securement of the Upper Segment*).—Before the final division is made, the upper end should be securely held to prevent its escape from the operator. It is then drawn down and fastened to the anal portion *without tension* by circular enterorrhaphy, Murphy's button, lateral implantation method, etc. When completely closed by sewing, fæcal fistulæ follow not infrequently at the posterior surface of the gut, due to the tearing out of the stitches at that point. However, division of the sphincter (Czerny) and inguinal colostomy (Schede) are practiced with success in the prevention of fistulæ in the cases of contemplated union by sewing. The final integrity of the normal sphincter is essential to the best outcome; therefore, disease of this portion of the bowel is especially burdensome. If a healthy sphincteric area be present, and the stump be of sufficient length to permit it to be drawn through the lower segment within the control of the sphincter, and stitched to the integument outside the anus, increased control of the opening is secured (Hochenegg). The removal of the mucous lining of the lower part, and freshening the anus, aid repair. *Morestin*, believing resection usually causes final paralysis of sphincter, removes the gut.

*Lange* successfully approximated the lower to a too short upper segment in the following manner: After resection of the diseased area and failure of suitable approximation, he secured upward displacement of the lower segment through the agency of a curved incision extending between the tuber ischii in front of the anus, and going down to and dividing some of the anterior fibers of the levator ani. Upward pressure on the flap thus formed caused a gain of two inches or so in aid of the approximation of the segments. Two cases are reported as treated by this method, in both of which satisfactory sphincteric action occurred only in the presence of solid fæces.

**Vicarious Sphincteric Control.**—The possibility of vicarious or normal control of the end of the bowel is a very important element of comfort and satisfaction to the patient and friends in determining whether or not to submit to operative procedure that contemplates the loss of the control of fæcal

discharge. In this connection it should be noted that fæcal incontinence does not solely depend on the integrity of the sphincters, but also on that of the functions of the mucous membrane of the points of exit. Thus, when the lower end of the rectum is removed and the proximal extremity sewed to the integumentary border, this extremity is not possessed of the inhibitory power of the antecedent part, and therefore temporary incontinence may result, which later disappears, in most instances, when the divided nerve connections are re-established. In the instance of proctectomy the following expedients for better control are sometimes practiced. Carrying the end of the rectum between the fibers of the gluteus maximus at the lower or upper part, as may best suit the length of the upper segment, is an ingenious measure devised by *Willems* and others, and can be commended as a harmless effort that has been followed with beneficent results on several occasions; in certain cases the utilization of the pyriformis for the purpose is commended.

*Gersuny* practiced torsion of a limited part of the upper segment between two forceps, until appreciable resistance attended the introduction of the index finger, then stitched the end to the skin margin, thus securing some retentive power at the lower end. Successful instances are cited of this method.

In connection with artificial anus various measures of control of the fæcal discharge have been devised, such as the drawing of the bowel through a vertical separation of the fibers of the outer edge of the rectus abdominis (Howse), and through a vertical and oblique division (von Hacker) at some

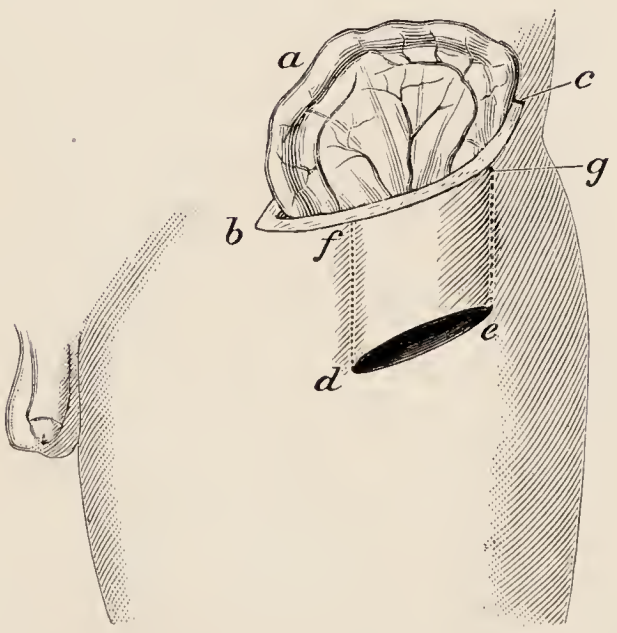



FIG. 1226.—Operation for vicarious sphincteric control. *a*. Loop of intestine. *b*, *c*. Opening in abdomen. *d*, *e*. Opening at anterior surface of thigh (Braun) for escape of intestine along channel limited by *f*, *d*, *g*, and *e*.

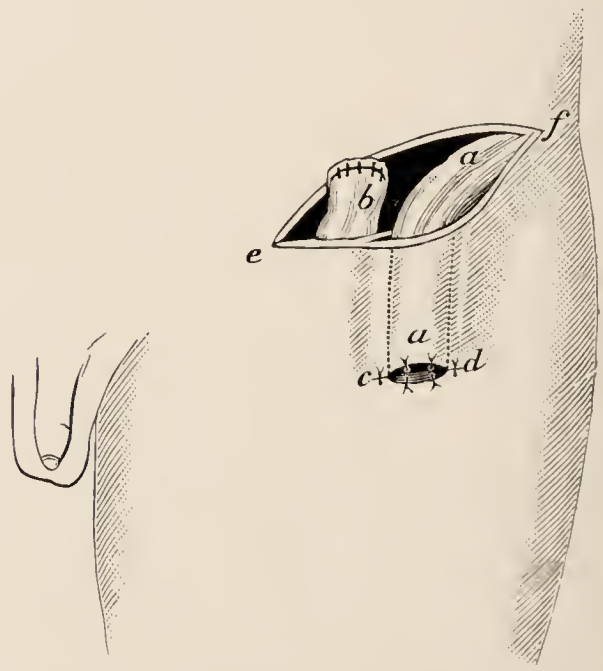



FIG. 1227.—Operation for vicarious sphincteric control. Braun's method. *a*, *a*. Proximal end of sigmoid and vicarious opening. *d*. Rectal end of sigmoid closed and dropped back into pelvis. *e*, *f*. Abdominal opening. *c*, *d*. Anal opening.

distance above the pubis, or through a vertical incision of the rectus immediately above that bone, supplemented by gouging of its upper border to provide a completer outlet (Roux). The separation (Maydl), instead of division of the muscular fibers, attended with stitching together of the arms

of the loop, are important features of successful outcome in these cases. The removal of the loop of intestine (Fig. 1226), the closure and dropping back of the rectal end into the pelvis (Fig. 1227), followed by transference beneath the skin of the upper end to a point below the crest of the ilium (Witzel), with or without narrowing of the end of the bowel, is admirable practice (Fig. 1228).

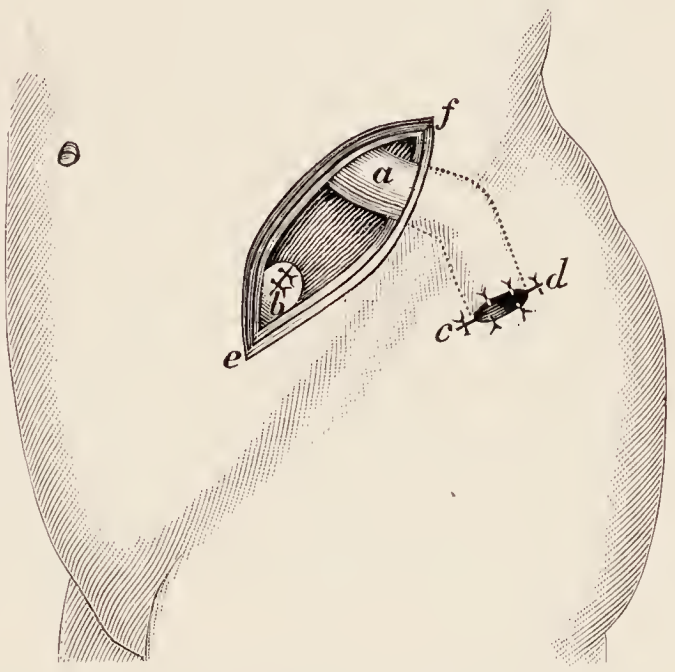



FIG. 1228.—Operation for vicarious sphincteric control, Witzel's method. *a*. Proximal end of sigmoid. *b*. Rectal end closed and dropped back into pelvis. *e*, *f*. Abdominal opening. *c*, *d*. Vicarious opening, sigmoid passing across crest of ilium.

*Maunsell's method* of enterorrhaphy can be practiced after the removal of the growth at the junction of the sigmoid and rectum, or in the event of recto-sigmoidal intussusception. It will not be amiss to emphasize the importance of the measure in the latter condition by reference to the illustrative case reported by Hartley.

"The tumor was exposed through a liberal median incision with the patient in Trendelenburg's position, and raised upward out of the pelvis as far as possible, and surrounded with gauze. An incision three inches in length was made over the lower segment entering the intestine — intussuscipiens (Figs. 906 and 910); the tumor and intussusceptum were delivered through this opening after protecting the mass with additional gauze. The intussusceptum was then divided transversely a little below its neck. The divided ends were held in position until the arteries in the mesenteric border were securely ligated. Silk sutures were then passed through all the coats of the intestines as they were held in position, according to Maunsell's recommendation, and tied (Fig. 908).

"One or two catgut ligatures were placed in the mucous membrane along where it gaped. The fold was then reduced, and a Lembert suture was carried around the intestine above the larger and deeper sutures. After this, the longitudinal incision in the lower segment was sutured by a few stitches of silk in the mucous membrane, and a Lembert suture in the serosa and submucosa. The cavity was wiped out with a sponge. The abdominal incision was closed with silkworm gut." The recovery in this case was prompt and uneventful.

*Murphy's button* can be made to exercise an important function in suitable cases of resection of the rectum. It should not be regarded, however, as a suitable substitute for the Kraske method of practice only in exceptional instances. It is employed in the following manner: Dilate the sphincter widely; draw down with forceps the diseased process; insert in an out-and-in manner through the wall of the bowel below the disease the puckering string; divide the bowel transversely a quarter of an inch above the string; seize the proximal segment with forceps and draw it down into

the distal, while separation above is being made with the fingers; insert half an inch above the disease another puckering string and divide the rectum half an inch below it, thus removing the disease; introduce the male portion of the button into the upper segment, and fasten it in place with its puckering string, which is then cut short; pass the female portion of the button up over the distal string until it catches the end of the male cylinder sufficiently to hold it in place; make a small parallel incision into the lower segment of the rectum over the coccyx and half an inch below the first puckering string; pass through the opening a strand of iodoform gauze for drainage, allowing it to remain in place for three or four days; draw the button into the distal end, confine it with the puckering string, which is cut short, and the segments of the button are then approximated. The bowels are kept loose during the presence of the button in the rectum. The button may be expected to come away on the tenth or twelfth day. The impossibility in many instances of removing all the disease, the limited space of action, and the difficulty in securing proper adjustment of the segments of the button are among the obstacles that unfit the appliance for general use.

*The General Remarks.—Quénu*, through a low colostomy, carried a solid sound, grooved at the end, down to within an inch of the growth, ligatured the bowel firmly in the groove, divided the gut, and slowly withdrawing the sound invaginated the rectum and fastened it to the wound above. *Keen*, after preliminary colostomy and removal of the disease, advises sewing up and dropping back into the sacral wound the cut end of the rectum and the closing perineal wound. Dividing or stretching the sphincter should be done in cases of extended disease; the latter is never amiss in enterorraphy or union by the Murphy button as a preventive measure of fistula. The hæmorrhoidal branches of the gut lie so closely in contact with the muscular wall that they are readily displaced along with the bowel, and for this reason are not injured if the mesocolon be divided close to the sacrum. The division at either side of the bowel of the peritonæum which holds it in place should be carefully practiced with scissors, to prevent injury of the contiguous vessels and obviate the danger of necrosis of the stump. The extent of the peritoneal division will be governed by the height of the growth in the bowel, and the degree of downward displacement required to secure proper adjustment of the stump without tension; if the disease be too extensive for removal the bone flap should be replaced and fixed in position. Careful enucleation of the disease should be practiced, as perforation, infection, and free bleeding will otherwise be caused, and after enucleation the closure of peritoneal wounds by sewing or gauze should be promptly made. Two iodoformized gauze ligatures may be carried around the bowel about an inch above the growth, the intestine severed between them with scissors, and the divided ends cleansed and wrapped in gauze, to prevent infection. *Quénu* and *Hartmann* regard free and easy access to the rectum and absolute asepsis as necessary to the attainment of the highest outcome. They advise that the process be isolated by means of elastic ligatures passed around the gut above and below the seat of the disease, and that, after making a circular incision around the anus, the anal opening be closed

by sewing and cautery applied to it for greater safety. The introduction of the finger into a cleansed rectum during operation is earnestly opposed by these authorities. In instances of recto-sigmoid involvement Quénu and Hartmann recommend closure of the anus, abdominal section, removal of the rectum, and the establishment of artificial anus in the abdominal wound. *Kraske*, of Freiburg, through an abdominal incision ties and severs the superior hæmorrhoidal artery between two ligatures, then divides and separates the rectal peritonæum, removing the enlarged lymphatic nodes in mesocolon and mesorectum without loss of blood. The anus should be placed in the sacral wound, if tension be too great to permit proper adjustment elsewhere of the upper segment, and liberal release above of the rectum should be made before union below is attempted. The wound should be packed with gauze, which is changed within forty-eight hours if fæcal escape be feared. In any instance it is dressed afterward as often as cleanliness demands. When granulation becomes well established, the patient can be up and around, and thus get the benefit of fresh air and returning confidence. In the instance of an anus of defective retaining force, a close-fitting pad should be worn.

*The Choice of Operation.*—Cancer of the rectum, like similar growths elsewhere in the body, may be treated radically whenever it is technically possible to remove the disease and the patient's condition warrants the attempt. The fact of contiguous involvement need not contraindicate the attempt, provided the preceding indications are available. The perineal method is suitable in those cases in which the disease is within easy reach, well defined, and the lumen of the gut amenable to proper control. Parasacral incision, with removal of the coccyx and perhaps without, affords ample room for the employment of the perineal method. Those cases in which the disease is located higher up than for the preceding method of attack are suitable for approach by the sacral route. *Krönlein* believes that the sacral route of approach should be reserved for removal of disease of the upper part of the rectum. *Mathews* regards the sacral route as dangerous, difficult, and unpromising. Many English surgeons share in this opinion, and limit their efforts to the availability of the perineal operation.

*The Results.*—Incontinence of fæces, fistula, stricture, and prolapse constitute the prominent sequels of the operation. If the sphincter be removed and the levator ani be greatly impaired, but little control will be had of the intestinal contents. However, the command is better if the bowel be not, than if it be, sutured to the skin under these circumstances, as in the former method greater cicatricial change will take place. It appears, so far as definitely stated, that complete incontinence of fæces happens in about 6 per cent, partial in about 9, and satisfactory control in the remainder of the cases. *Fistula* results from imperfect union dependent on tension, defective sewing, infection, etc. Many fistulæ heal quite promptly with the use of bougies and proper cleanliness; others require special operation for cure. *Stricture:* Every form of union of the segments is (1 in 10) liable to be followed by stricture at the seat of junction. The knowledge of this liability should be forestalled by frequent inspection and a discreet use of bougies.

*Prolapse* of the rectum (rare before Kraske's method) is the outcome commonly of impairment of the sacral floor; therefore the importance of this defect should be heeded and the meso-rectum should be thoroughly repaired. The general death rate of the sacral method of operation is from 18 to 25 per cent. The final outlook in highly favorable cases is gratifying, as 75 per cent of Kocher's operative recoveries were alive and well four to sixteen years after operation; 62 per cent of Czerny's cases were free from disease when reported, a third of which were of two years' standing. *Hochenegg* reports the operation mortality in his cases at 8.2 per cent, and the cure at 25 per cent. He no longer operates for recurrence. *Krönlein* has collected 881 cases, from German sources, of extirpation of the rectum by the radical method, showing a rate of mortality of 20 per cent and cure of 14.30 per cent. He concludes that the best functional results follow when the proximal end of the gut is caused to occupy the normal site of the anus, and when the sphincters are preserved; also that the removal of all the rectal structures does not increase the rate of permanent cure and is followed by the worst of functional results.

In *Tuttle's* late and exhaustive paper appears the following instructive facts bearing on this topic, based on the results in about 600 cases here and abroad:

FINET'S SYNOPSIS OF CASES.

| | |
|---|---|
| Immediate deaths | 66 |
| Deaths under 1 year, cause not given, 8; deaths between 1 and 2 years, 3; deaths between 2 and 3 years, 1 | 12 |
| Deaths from recurrence *in situ*, under 1 year, 17; metastasis under 1 year, 12; *in situ*, between 1 and 2 years, 2; metastasis between 1 and 2 years, 1; *in situ*, between 2 and 3 years, 3; metastasis between 2 and 3 years, 1 | 36 |
| Living with recurrence under 1 year, 18; under 2 years, 1; under 3 years, 1; over 3 years, 2 | 22 |
| Living without recurrence under 1 year, 124; under 2 years, 11; 3 years, 23; 4 to 5 years, 10; 5 to 6 years, 7; 6 to 7 years, 6; 7 to 8 years, 5; 8 to 10 years, 5; 10 to 11 years, 3; 11 to 12 years, 1; 12 to 14 years, 1; 14 to 15 years, 2; 15 to 16 years, 1; over 16 years, 2 | 201 |
| Died without recurrence after 4 years, 4 | 4 |
| Mortality, 19 per cent | 341 |

TUTTLE'S SYNOPSIS OF CASES.

| | |
|---|---|
| Immediate deaths | 31 |
| Deaths under 1 year, recurrence *in situ*, 8; by metastasis, 6; between 1 and 2 years, recurrence *in situ*, 4; by metastasis, 3; between 2 and 3 years, recurrence *in situ*, 4; by metastasis, 2; after 3 years, recurrence *in situ*, none; by metastasis, 1 | 28 |
| Living with recurrence under 1 year, 6; between 1 and 2 years, 5; 1 each 2, 4, 2, 2, $2\frac{1}{2}$, 4 years | 17 |
| Living without recurrence under 1 year, 90; over 1 and under 2 years, 48; over 2 and under 3 years, 20; over 3 years, 23 | 181 |
| Mortality, 11.7 per cent | 257 |

Sacral, 173 cases, 23 deaths; mortality, 13.3 per cent. Perineal, 70 cases, 5 deaths; mortality, 7.1 per cent. Vaginal, 1 death; anal, 1 death; not given, 1 death.

**Colorectostomy.**—Colorectostomy can be practiced at the lower part of the sigmoid flexure through a median abdominal or the sacral incision. *In the former method* paralyze the sphincter by overdistention, and wash out the rectum; place the patient in Trendelenburg's position, and make an abdominal incision in the median line from the symphysis to the navel; excise the growth, if feasible, and close the distal end of the gut with sutures. If excision be not feasible, divide the colon above the growth and close the distal end as before; pass through the borders of the open proximal end six strong, silk traction sutures, leaving the ends of each suture not less than ten inches in length; thrust through the anus up the rectum along its anterior wall to within two inches of the growth, or against the closed end (if the growth have been removed), a long-handled forceps or a sponge holder; make an incision an inch in length at the peritoneal aspect of the rectum down upon the instrument with a bistoury; pass the forceps through the opening and seize the twisted bundle of traction sutures; withdraw the forceps with the sutures from the bowel, and by gentle traction cause the "telescoping" of the upper segment into the lateral incision of the lower the desired distance, which should be not less than half an inch; unite with sutures at the pelvic side the infolded serous surface of the lower segment with the serous covering of the upper, if possible, holding the parts firmly by the traction sutures during the sewing (Fig. 1229). Wash out the pelvis with a warm saline solution, and adjust strips of iodoform gauze packing around the colorectal junction, allowing the ends to escape from the lower angle of the abdominal wound, the remaining portion of which is closed; if no evidence of fæcal leakage be seen at the end of four or five days, withdraw the gauze and close the wound almost entirely.

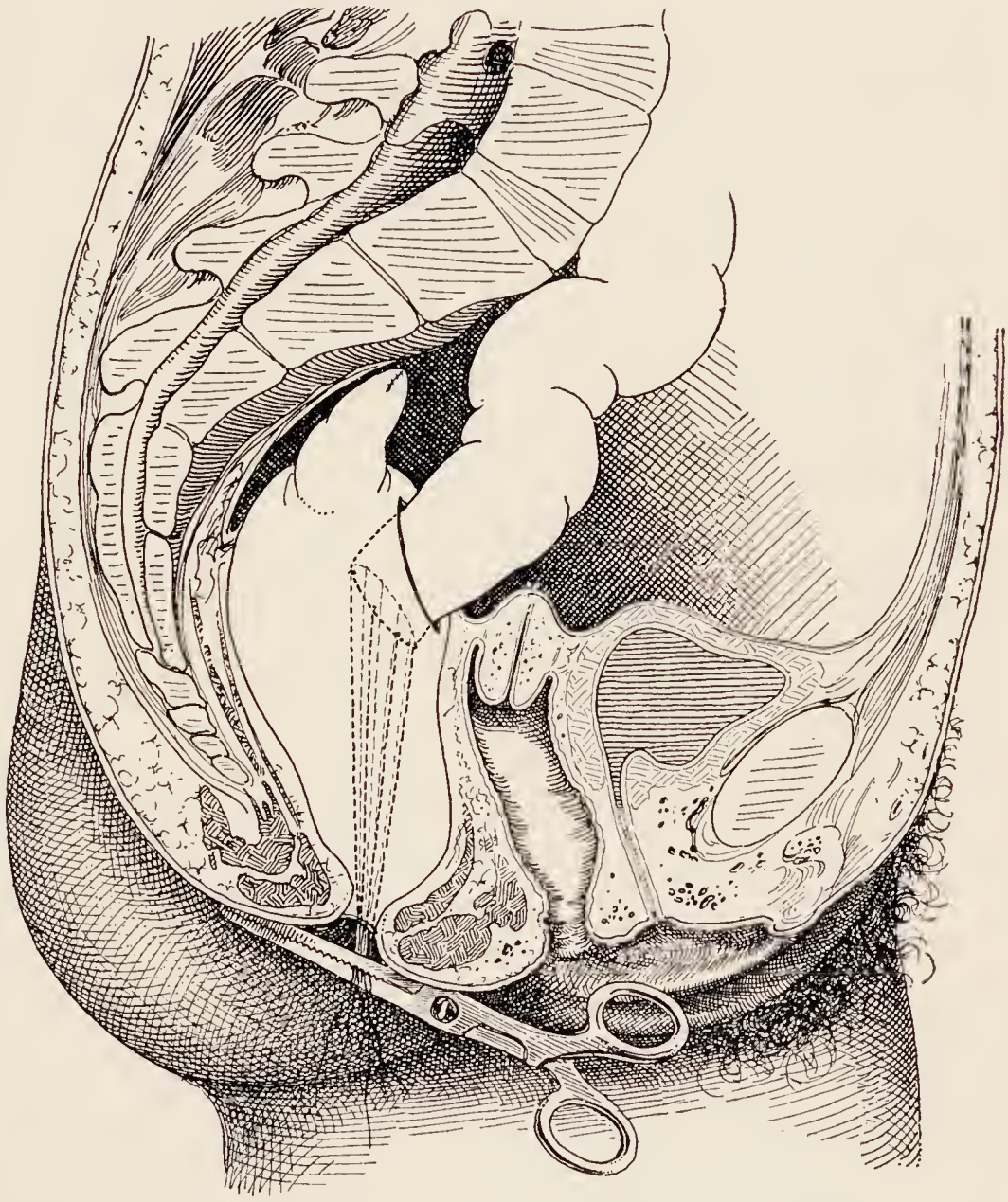


Fig. 1229.—The operation of colorectostomy. Removal of the upper part of the rectum, with the uterus, tubes, and ovaries. The union of sigmoid and rectum should be made by sero-serous sutures.

**Sacral colorectostomy** is quite readily done after reflection of the osteocutaneous flaps, in the same manner as with the median incision (Uhlmann). It has been suggested, in order to obviate the rectal obstruction and the formation of an artificial anus, through a median incision, to stitch a loop of sigmoid to the rectum below the seat of the disease, and make an opening at the site of union by way of the rectum, after adhesion has taken place (Bacon).

**Vaginal Proctectomy.**—The approach to the rectum through the vagina has a limited and as yet undeveloped availability. After the usual antiseptic preparatory treatment of the rectum, vagina, and cervix uteri, empty the bladder and tampon the rectum; make an incision in the posterior wall of the vagina from the cervix to the perinæum down to the sphincter and levator ani fibers; separate the rectum from below upward, and draw it forward at the same time; arrest hæmorrhage, and remove the necessary portion of the gut, as already described; draw the bowel down and stitch it to the borders of the wound in the usual manner; close the vaginal wound with sutures, and apply gentle coaptation compression to the seat of operation by vaginal tampon. *Heydenreich* believes that this route should be limited to those cases in which the vagina is not impaired at the point of division, and in which the disease is limited to the lower four or five inches of the bowel. He extends the incision to the coccyx, thereby forming two posterior flaps. Heydenreich claims that less shock and less liability to fistula and fæcal incontinence attend this than the sacral method. *Rehn* commends the method, practiced singly or with abdominal incision.

*The Results.*—Eleven successful cases and one death by this method are reported.

*Murphy* reports* five comparatively late cases of his own of resection of the rectum *per vaginam*. After describing the steps of the operation, he states its advantages as follows:

"1. The sacrum and posterior bony wall of the pelvis are not disturbed.

"2. The field of operation is as extensive and the anatomical parts as accessible as in the trans-sacral operations.

"3. The peritoneal cavity is opened in both the vaginal and sacral operations, and in neither is it a source of great danger.

"4. The diseased tissue is more accessible for inspection, and the extent to which the operation may be carried in an upward direction is as great, if not greater, than by the sacral route.

"5. The peritonæum may be drained freely through the vagina.

"6. A perfect end-to-end approximation, either by suture or by the use of the button, may be secured. The preferable method of uniting the two ends is by interrupted sutures of silk, because, as there is no peritonæum on the sphincteric segment, failure of union with the button is to be feared.

"7. The sphincter is retained and the perineal body is restored. There is diminished action of the levator ani muscle.

"8. When the operation is complete the parts are practically in their normal positions."

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* Philadelphia Medical Journal, February 23, 1901.

## CHAPTER XVI.

### *OPERATIONS ON THE THORAX.*

**Excision of the Breast.**—The excision of the female breast for the cure of malignant tumor of the organ is for many reasons quite as conspicuous a procedure from the lay standpoint as belongs to the field of surgical endeavor. The frequency of the occurrence of these growths, and the certainty and the suffering of the natural outcome, invest the patients with the full measure of human sympathy and tender consideration. On the other hand, the initial delay in the acknowledgment of the presence of suspected infliction, supplemented by the procrastination in diagnosis and treatment, rob the victim of the best opportunities of cure, and thus encourage skeptical advisers in the utterance of their dismal prophecies. Not until the presence of a suspicious growth is promptly acknowledged, and the diagnosis and removal are promptly and completely made will the rate of recovery from malignant disease be much more increased.

When it is recalled that about eighty-two per cent of tumors of the breast are of a malignant nature, and that secondary infection has already occurred in the great majority of cases when the attention of the surgeon is called to them, the need for increased vigilance and prompt operative action is apparent and should be emphasized by a carefully conducted explorative incision, if need be, to determine the nature of the growth.

"Permanent results will follow the operative treatment of carcinoma if the operation is performed before regional infection has occurred; on the contrary, non-recurrence will be the exception and recurrence the rule if the primary tumor is not removed until regional infection sets in" (Senn).

*The Anatomical Points.*—The relations of the lymphatic glands of the breast to those of the axillary, pectoral, supraclavicular, and infraclavicular regions are of great importance as bearing on the measures of detection and removal of malignant disease and of its forestallment in these structures. The normal axillary glands are of comparatively large size, about ten or twelve in number, and are arranged in three more or less distinct chains or series. One chain surrounds the axillary vessels, therefore is imbedded in loose areolar tissue. The lymphatics of the arm are continuous with this chain. Another, a small chain, runs along the lower border of the pectoralis major, receiving the lymphatics from the chest and breast. The third is situated at the posterior border of the axilla, and receives the lymphatics from the back. The series communicate with each other in the axilla, but

not so freely as with lymphatics of the structures located closely to them. The axillary and deep cervical lymphatics communicate with each other through the agency of two or three lymphatic glands situated beneath the clavicle. The superficial cervical lymphatic glands immediately above the clavicle are connected at that situation with the deep ones beneath. Although, as before stated, the major portion of the lymphatic vessels of the mamma empty into the anterior axillary series, still, many from the inner margin of the gland pass directly through the intercostal spaces to communicate with the mediastinal lymphatics (Fig. 1230). The lymphatic vessels of the pectoral muscles and their fascia are connected with those of the mamma, and they pass from the gland through the fatty tissue beneath to establish this connection. The deep lymphatics of the inferior surface of the gland accompanying the aortic intercostals at the outer side of the gland going to the thoracic duct in the posterior mediastinum. The perivascular spaces of the small vessels sometimes teem with cancer cells carried along by the lymph current. It seems not altogether improbable that the early blocking of the axillary lymph channels by cancer products hastens their diffusion through the minuter and more obscure channel to practically inaccessible parts of the body. The intercostal branches of the internal mammary artery contribute freely to the vascular supply of the gland, especially the perforating branches at the inner margin, which often bleed freely and are difficult to secure if severed flush with the intercostal structures. *The muscular guide to the axilla* may be regarded as the outer border of the pectoralis major muscle. The grosser anatomical points relating to the mamma, axilla, etc., are common matters in any standard work on anatomy, and need not, therefore, encroach unnecessarily upon the operative propriety at this time.

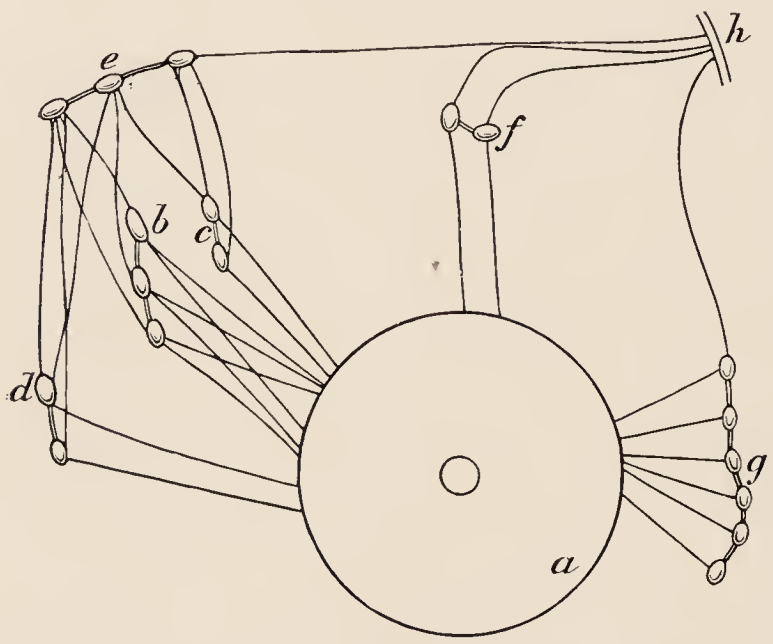



Fig. 1230.—A scheme of important lymphatic associations of mammary gland. *a*. Mammary gland. *b*. Lymph nodes of long thoracic vessels. *c*. Lymph nodes between pectoral muscles. *d*. Lymph nodes in middle of axilla. *e*. Lymph nodes of axillary vein. *f*. Lymph nodes in costo-coracoid membrane. *g*. Lymph nodes in anterior and superior mediastina. *h*. Right lymph duct.

*The special local preparation of the patient* relates to thorough antiseptic cleansing of the breast, arm, axilla, and the contiguous surfaces, and their isolation by antiseptic towels. The axilla especially should have been closely shaven and cleansed, and ulcerated surfaces in the field of operation so purified and isolated as to cause no infection.

*The Primary Incision.*—The varieties of the primary incisions now employed in the removal of the breast are considerable, and some, indeed, are rather more fanciful than practical. An incision that offers ample opportunity for free inspection and wide removal of diseased tissue and associated

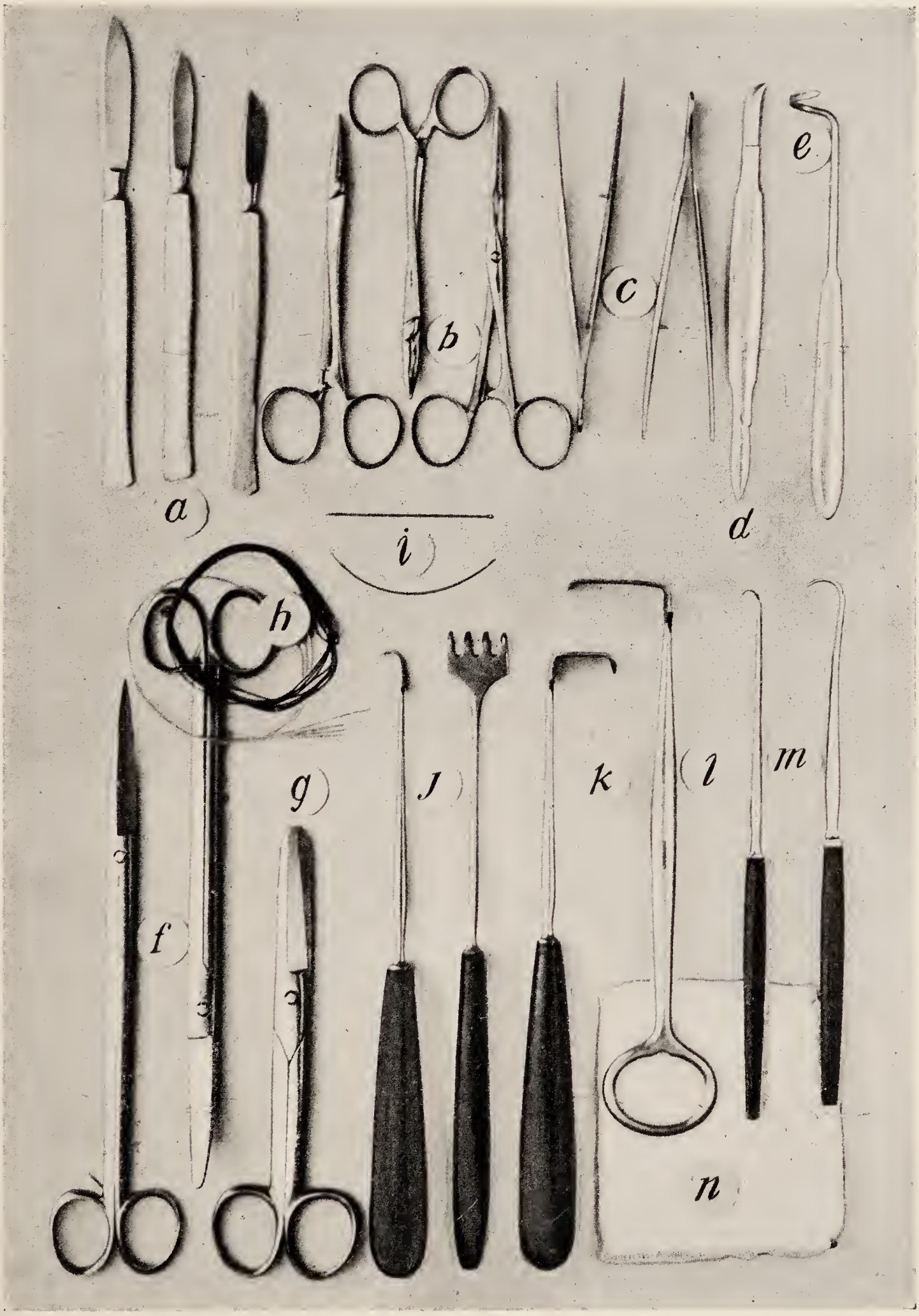



FIG. 1231.—Instruments employed in excision of the mammary gland.

*a*. Scalpels. *b*. Forcipressure. *c*. Dissecting and mouse-tooth forceps. *d*. Blunt dissector. *e*. Aneurism needle. *f*. Long blunt- and sharp-pointed scissors. *g*. Short blunt-pointed scissors. *h*. Catgut and silkworm gut. *i*. Long and curved needles. *j*, *k*. Blunt and hooked retractors. *l*. Tenaculum. *m*. Blunt hook. *n*. Wiper. Forcipressure, ligatures, sutures, and wipers in abundance are needed, and rubber drainage tubing should be at hand.

lymphatics may be regarded as suitable for operative attainment, irrespective of previous designation for the purpose.

**Kocher's Incision** (Fig. 1232).—The outline of Kocher's incision is practically similar to Halsted's, but is placed in a reverse manner (Fig. 1238). The lower part of the incision corresponds to the axillary border of the pectoralis major and the upper extremity to a point just outside the middle of the clavicle. Through this portion of the incision the pectoralis major and minor are readily divided, the axilla freely exposed, and the vessels and nerves are disclosed up to the clavicle. The inner part of the incision is made so as to include the diseased gland and the proper amount of contiguous tissue. Kocher's incision is well suited for radical operations.

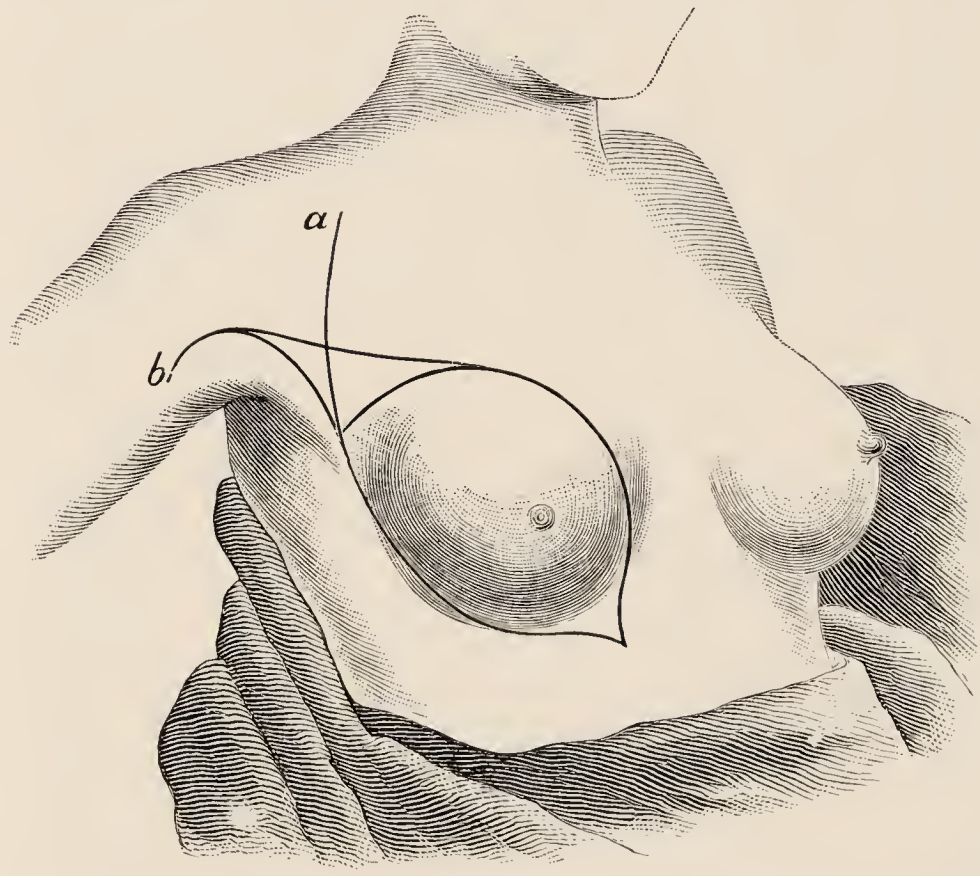



FIG. 1232.—The operation of excision of the breast. *a*. Line of Kocher's incision. *b*. Line of Senn's incision.

**Senn's (E. J.) Incision.** — After circumscribing the breast, as noted in the illustration, the incision is continued at the outer border of the pectoral muscle upward to a point an inch above the border of the axilla, thence in an outward curved manner terminating at a point corresponding with the apex of the axilla. This incision permits free and early exposure of the vein, and removes from the axilla a line of union which is often irritated by perspiration, capillary growth, and imperfect asepsis, and also a scar that may cause subsequent annoyance. *Hartley*, *Keen*, *Weir*, the writer, and others have employed this modification for three years or more with satisfaction.

**Warren's Method** (Fig. 1233).—*Warren* makes a pear-shaped incision, which, with removal of the breast, he describes as follows:

"An incision is made from the anterior margin of the axilla along its anterior border, or slightly above, and the line of the pectoralis major muscle around the lower border of the breast to a point on the boundary line of the inner and lower quadrant. A second incision begins at the middle of the anterior axillary fold and gradually diverges from the first incision as it approaches the breast, when it sweeps around the upper border of the organ to meet that incision again at its terminal point. The amount of skin thus included is pear-shaped, the point being at the upper axillary margin. The direction of these incisions varies somewhat according to the locality of the nodule; but a very large amount of tissue should be surrounded by them,

usually the whole breast, and occasionally a portion of the adjacent integuments. The edges of the wound should be reflected back and the dissection made so as to expose the margin of the mammary gland. The knife is now carried down to the pectoralis major muscle, which is freely exposed along the line of the whole upper incision. The sternal portion of the pectoralis major muscle is now separated from the thorax, and the whole mass to be removed is thrown outward. The muscle is divided near its humeral insertion. This exposes freely the pectoralis minor and the axilla. Should the upper incision have been carried some distance below the clavicle, a third incision (*a*) may now be made at right angles to the first, so as to lay bare the axillary vessels up to the point where they pass beneath the clavicle. The pectoralis minor should now be divided and its halves reflected or removed. The dissection of the axilla follows next, the axillary vessels being carefully cleansed of all adipose tissue from their point of emergence beneath the clavicle down to and through the axilla. Special attention should be paid to a prolongation of adipose tissue, which lies in front of the vessels, and a similar tongue of tissue which runs up behind them. A thin, blade-like mass of adipose tissue lying between the serratus magnus and the subscapularis should also receive the attention of the surgeon, for here numerous shotlike glands are found in the more malignant forms of the disease. As the dissection of the axilla proceeds the branches of the large vessels are cut and tied, and also any thoracic or scapular nerves which interfere with a thorough cleansing of the part are cut. The contents of the axilla are now reflected outward, together with the mamma and pectoral muscles; a few long sweeps of the knife loosen the outer attachments of the mamma, and the whole infected area is separated from the body in one continuous mass.

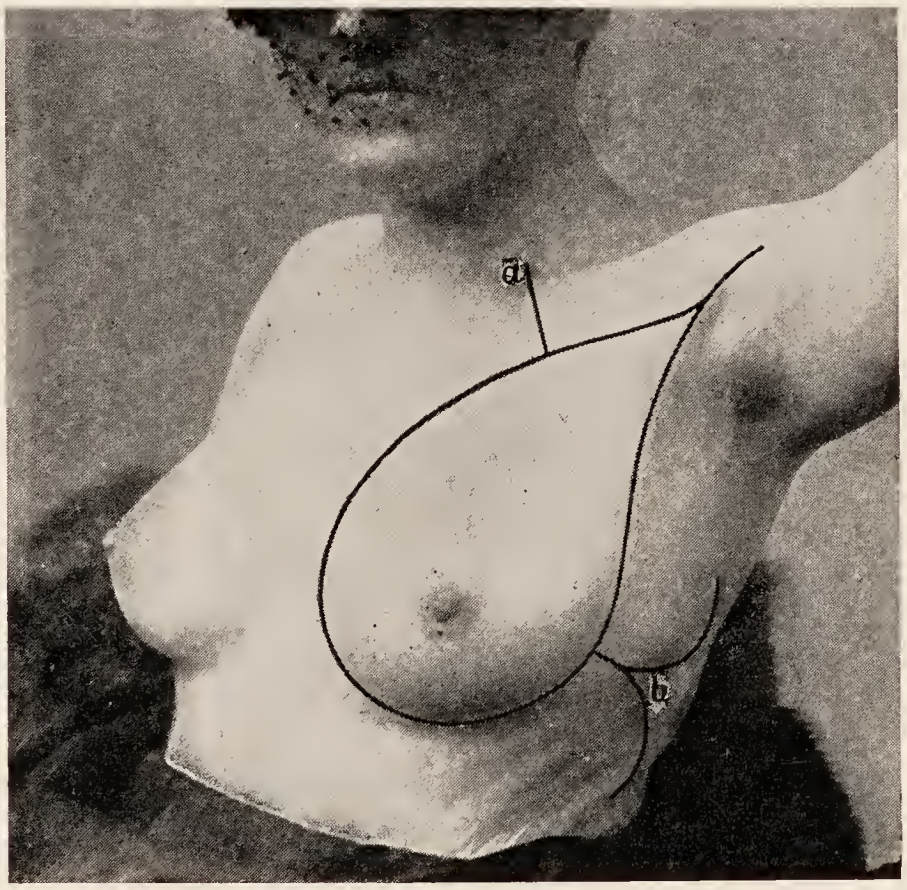



FIG. 1233.—Excision of the breast. Warren's lines of incision. *a*. Incision to clavicle. *b*. Incisions for secondary flaps.

"If there is any reason to suspect an infection of the supraclavicular glands, the vertical incision should be extended above the clavicle; the posterior cervical triangle can thus be exposed and its contents dissected. Division of the clavicle does not add materially to the exposure of the region."

The secondary incisions at the side of the chest (*b*) are for the purpose of forming flaps with which to close the wound when approximation of the borders will not suffice and when skin grafting is not regarded with favor.

**Cheyne's Incisions, etc.** (Figs. 1234, 1235, and 1236).—It should be noted that these incisions include not only the skin covering the entire breast, but also a decided increase of the area at the aspect of the organ bearing the disease. *Cheyne* does not carry the incision straight down to the muscle, but instead dissects up only sufficient of the underlying fat along with the skin to preserve the vitality of the latter, thus leaving behind and still connected with the tumor the outlying lobules of the breast and the lymphatics and vessels contained in the deeper fat which are connected with the growth, thereby excluding these elements of danger and rendering easier the final closure of the wound. The pectoral fascia is invariably removed and at least a superficial layer of the great pectoral muscle, along with the diseased gland and the deep fat, preferably in a common mass. When diseased, the pectoral muscles are entirely removed. The fasciæ connected with these muscles ought always to be removed.

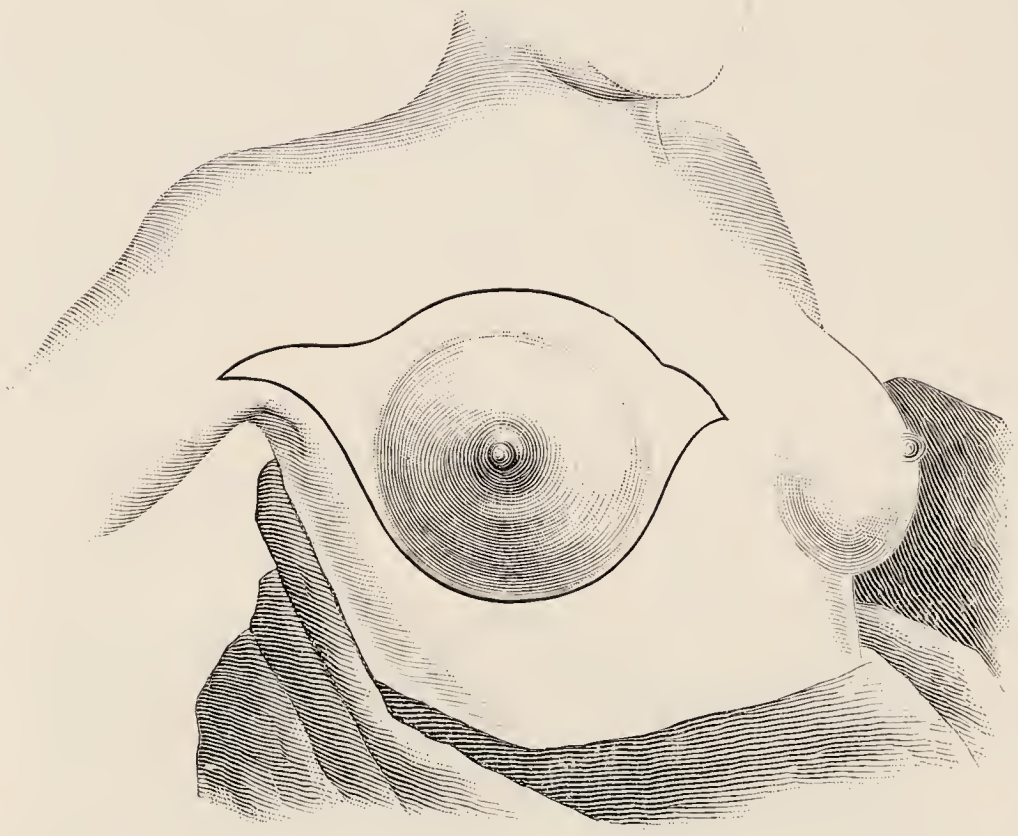


FIG. 1234.—Excision of the breast. Cheyne's line of incision for removal with central involvement.

Cheyne does not clear the posterior triangle of the neck unless he detects enlargements there, or finds infected nodules in the fat lying behind the vessels extending into the triangle.

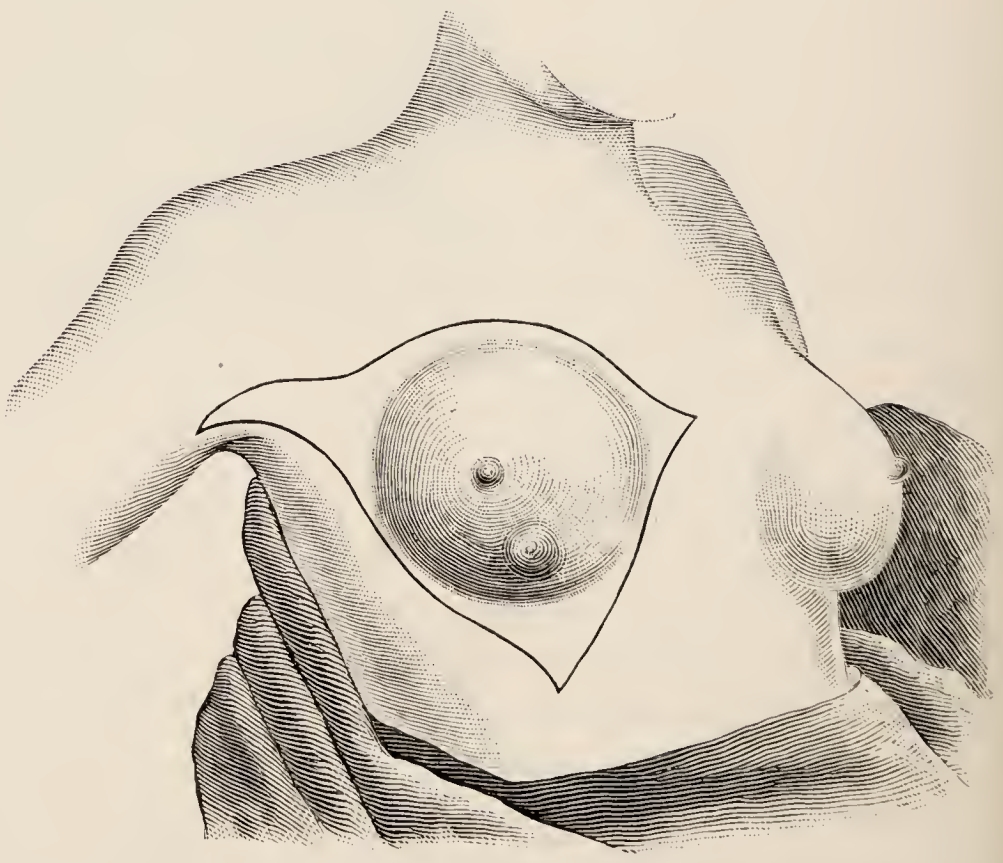


FIG. 1235.—Excision of the breast. Cheyne's line of incision for removal in involvement of the lower border.

**The Methods of Operation.**—The radical methods of practice and the so-called common method are recognized. The latter is superior in many

respects to other non-radical methods of operative relief of a comparatively recent date. The former methods are the outgrowth of patient study of operative results, based on a technique comprehending the wide removal of malignant manifestations, together with their prospective seats of occurrence when practicable. Warren's and Cheyne's methods are examples of this class.

*The Position of the Patient.*—Usually the patient is placed on the back, near to the edge of the table, the head and shoulders raised, and the arm extended from the side and retained in position by an assistant, an incision is made, which is varied according to the plan of procedure adopted by the surgeon.

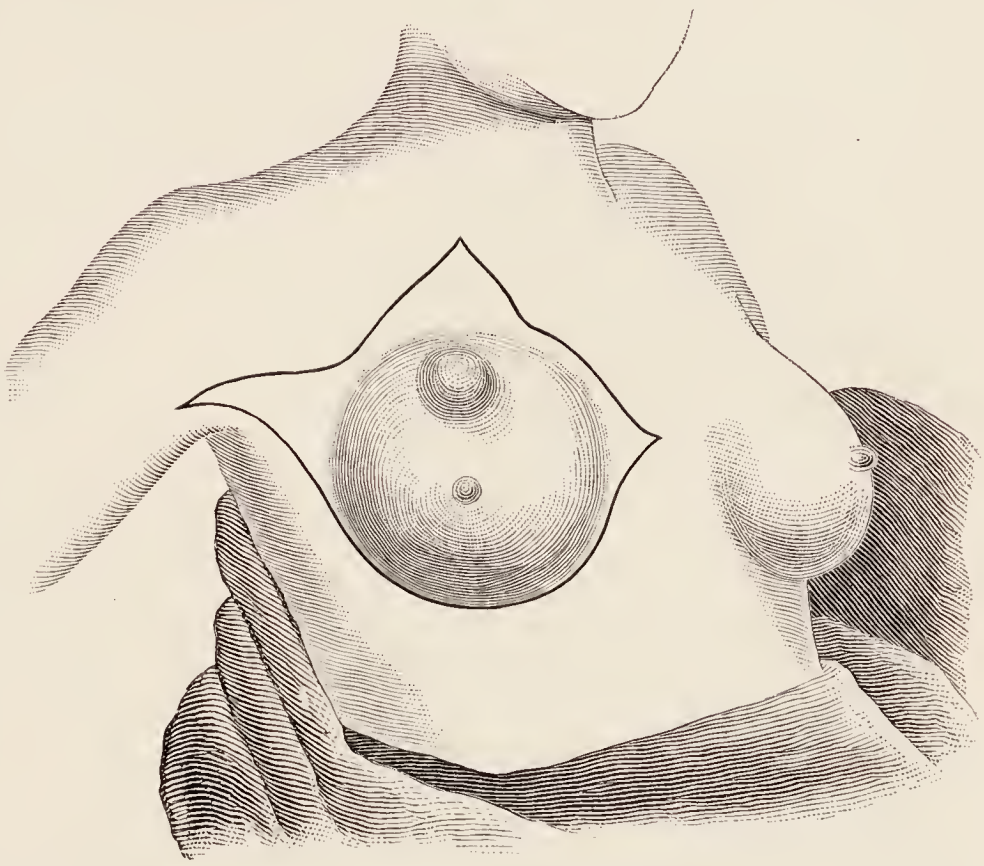


Fig. 1236.—Excision of the breast. Cheyne's line of incision for removal in involvement of the upper border.

**Halsted's Method** (*Radical*).—The excellent results secured by Halsted require, it seems to us, that the technique as practiced by him be presented only in his own language. Halsted's method of practice is based on the proposition that the pectoralis major muscle, entire or all except its clavicular portion, should be excised in every case of cancer of the breast, because the operator is enabled thereby to remove in one piece all of the suspected tissues.

"The suspected tissues should be removed in one piece (Fig. 1237), (1) lest the wound become infected by the division of tissues invaded by the disease or of lymphatic vessels containing cancer cells, and (2) because shreds or pieces of cancerous tissue might readily be overlooked in a piecemeal extirpation.

"1. The skin incision is carried at once and everywhere through the fat (Fig. 1238).

"2. The triangular flap of skin, *b*, *a*, *c*, is reflected back to its base line, *c*, *b*. There is nothing but skin in this flap. The fat which lined it is dissected back to the lower edge of the pectoralis major muscle, where it is continuous with the fat of the axilla.

"3. The costal insertions of the pectoralis major muscle are severed, and the splitting of the muscle, usually between its clavicular and costal portions, is begun and continued to a point about opposite the scalenus tubercle on the first rib.

"4. At this point the clavicular portion of the pectoralis major muscle and the skin overlying it are cut through hard up to the clavicle. This cut exposes the apex of the axilla.

"5. The loose tissue under the clavicular portion (the portion usually left behind) of the pectoralis major is carefully dissected from this muscle as the latter is drawn upward by a broad, sharp retractor. This tissue is rich in lymphatics, and is sometimes infiltrated with cancer (an important fact).

"6. The splitting of the muscle is continued out to the humerus, and the part of the muscle to be removed is now cut through close to its humeral attachment.



FIG. 1237.—Excision of the breast, Halsted's method. Tissues removed *en masse*.

"7. The whole mass —skin, breast, areolar tissue, and fat—circumscribed by the original skin incision is raised up with some force, to put the submuscular fascia on the stretch as it is stripped from the thorax close to the ribs and pectoralis minor muscle. It is well to include the delicate sheath of the minor muscle when this is practicable (Fig. 1239).

"8. The lower outer border of the minor muscle having been passed and clearly exposed, this muscle is divided at right angles to its fibers and at a point a little below its middle.

"9. The tissue, more or less rich in lymphatics and often cancerous, over the minor muscle, near its coracoid insertion, is divided as far out as possible, and then reflected inward in order to liberate or prepare for the reflection upward of this part of the minor muscle.

"10. The upper outer portion of the minor muscle is drawn upward with a broad, sharp retractor (*a*). This liberates the retractor, which until now has been holding back the clavicular portion of the pectoralis major muscle.

"11. The small blood-vessels (chiefly veins) under the minor muscle, near its insertion, must be separated from the muscle with the greatest care.

These are imbedded in loose connective tissue which seems to be rich in lymphatics, and contains more or less fat. This fat is often infiltrated with cancer. These blood-vessels should be dissected out very clean and immediately ligated close to the axillary vein. The ligation of these very delicate

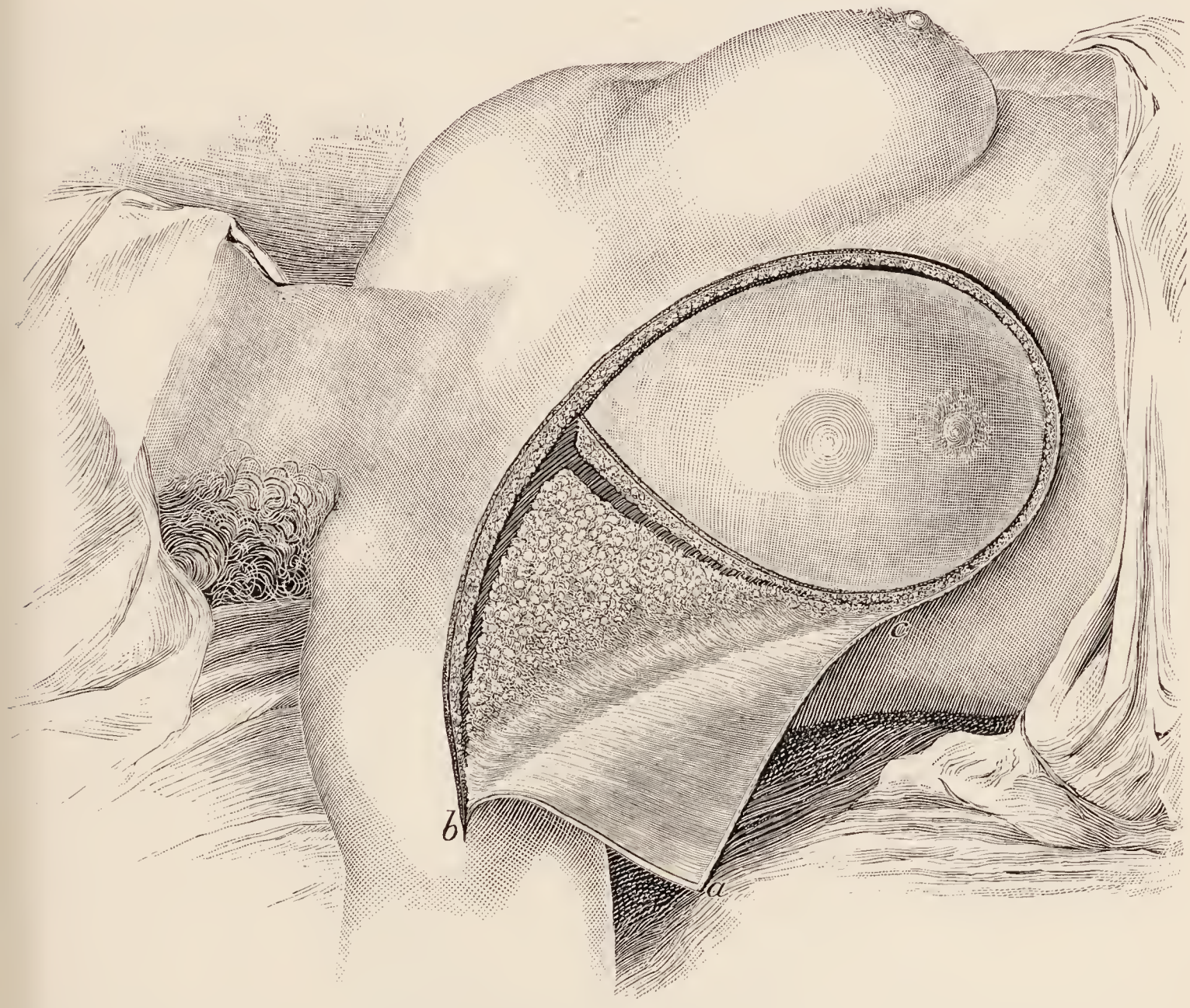



FIG. 1238.—Excision of the breast, Halsted's method. *b*, *a*, *c*. Triangular flap. *b*, *c*. Base line.

vessels should not be postponed, for the clamps occluding them might of their own weight drop off or accidentally be pulled off, or the vessels themselves might be torn away by the clamps. Furthermore, the clamps—so many of them—if left on the veins would be in the way of the operator.

"12. Having exposed the subclavian vein at the highest possible subclavicular point, the contents of the axilla are dissected away with scrupulous care, also with the sharpest possible knife. The glands and fat should not be pulled out with the fingers, as advised, I am sorry to say, in modern text-books and as practiced very often by operators. The axillary vein should be stripped absolutely clean. Not a particle of extraneous tissue should be included in the ligatures which are applied to the branches, sometimes very minute, of the axillary vessels. In liberating the vein from the tissues to be removed, it is best to push the vein away from the tissues, rather than hold the vein and push the tissues away from it. It may not

always be necessary to expose the artery, but I think that it is well to do this, for sometimes, not usually, the tissue above the large vessels is infiltrated, and we should not trust our eyes and fingers to decide this point. It is best to err on the safe side, and to remove in all cases the loose tissue above the vessels and about the axillary plexus of nerves.

"13. Having cleaned the vessels, we may proceed more rapidly to strip the axillary contents from the inner wall of the axilla—the lateral wall of the thorax. We must grasp the mass to be removed firmly with the left hand, and pull it outward and slightly upward with sufficient force to put on the stretch the delicate fascia which still binds it to the chest. This fascia is cut away close to the ribs and serratus magnus muscle.

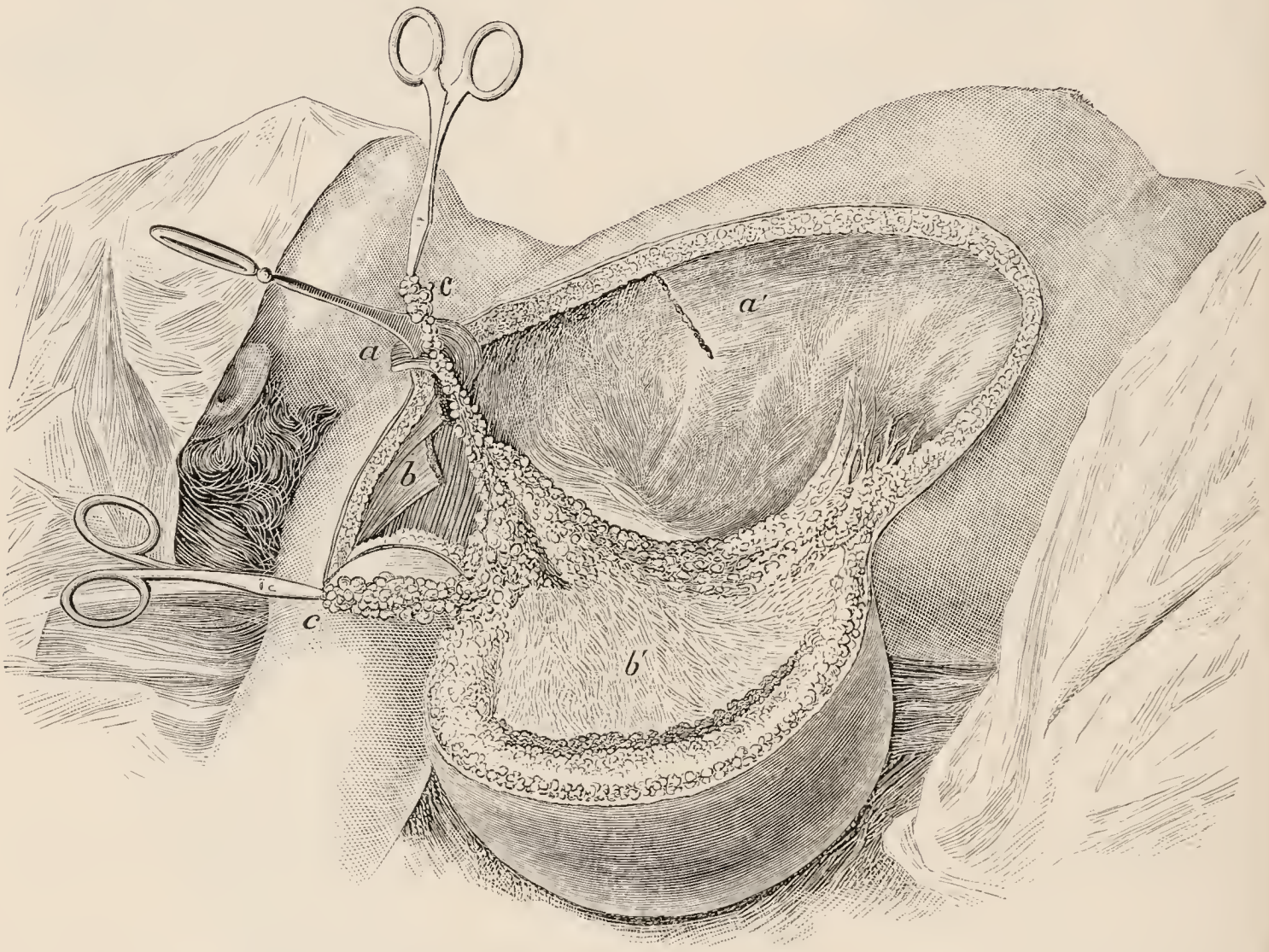



FIG. 1239.—Excision of the breast, Halsted's method. *a*. Reflected part of pectoralis minor muscle. *a'*. Central part of pectoralis minor muscle. *b*. Humeral insertion of sternal portion of pectoralis major. *b'*. Severed part of sternal portion of pectoralis major. *c*, *c'*. Fatty prolongations bearing lymph nodes.

"14. When we have reached the junction of the posterior and lateral walls of the axilla, or a little sooner, an assistant takes hold of the triangular flap of skin and draws it outward, to assist in spreading out the tissues which lie on the subscapularis, teres major, and latissimus dorsi muscles. The operator having taken a different hold of the tumor, cleans from within outward the posterior wall of the axilla. Proceeding in this way, we make easy and bloodless a part of the operation which used to be troublesome and bloody. The subscapular vessels become nicely exposed and caught before they are divided. The subscapular nerves may or may not be removed, at the discretion of the operator. *Küster* lays great stress upon the importance

of these nerves for the subsequent usefulness of the arm. We have not as yet decided this point to our entire satisfaction, but I think that they may often be spared to the patient with safety.

"15. Having passed these nerves, the operator has only to turn the mass back in its normal position, and to sever its connection with the body of the patient by a stroke of the knife from *b* to *c*, repeating the first cut through the skin.

"The edges of the wound are approximated by a buried purse-string suture of strong silk. Of the triangular flap of skin (*b*, *a*, *c*) only the base is included in this suture. The rest of this flap is used as a lining for the fornix of the axilla. The apex (*a*) of this flap is consequently shifted to a new and lower position. The axilla is never drained, and invariably heals by first intention. The uncovered wound often heals by the so-called organization of the blood clot."

**Meyer's Method** (*Radical*).—Meyer's plan of action, with which Halsted's is sometimes historically associated, while seeking the same ends as the latter, differs somewhat in the details, and, like it, is substantially quoted in full for the benefit of the operator.

*The Operation.*—"Make the primary incision as usual, embracing a liberal piece of skin around the nipple (Fig. 1240, *a*, *d*), which incision is at once run up into the axillary cavity, about an inch and a half to two inches farther than in the ordinary operation (*d*). This is done in order more easily to reach the tendon of the pectoralis major muscle on the humerus; make an additional skin incision from the clavicle at the junction of its middle and outer thirds downward, meeting the first wound at right angles (*c*, *d*); reflect the skin flaps, with as thin a layer of the underlying fat as possible, leaving just enough so as not to endanger a future necrosis of the flaps, exposing (Fig. 1241): 1. The insertion of the pectoralis major (*p*) muscle to the clavicle and sternum. 2. The insertion of the same muscle to the humerus (*t*), the cephalic vein (*c*, *v*) in Mohrenheim's subclavicular space. 3. The border of the latissimus dorsi muscle (*l*, *d*); divide the pectoralis major muscle in its tendon close to

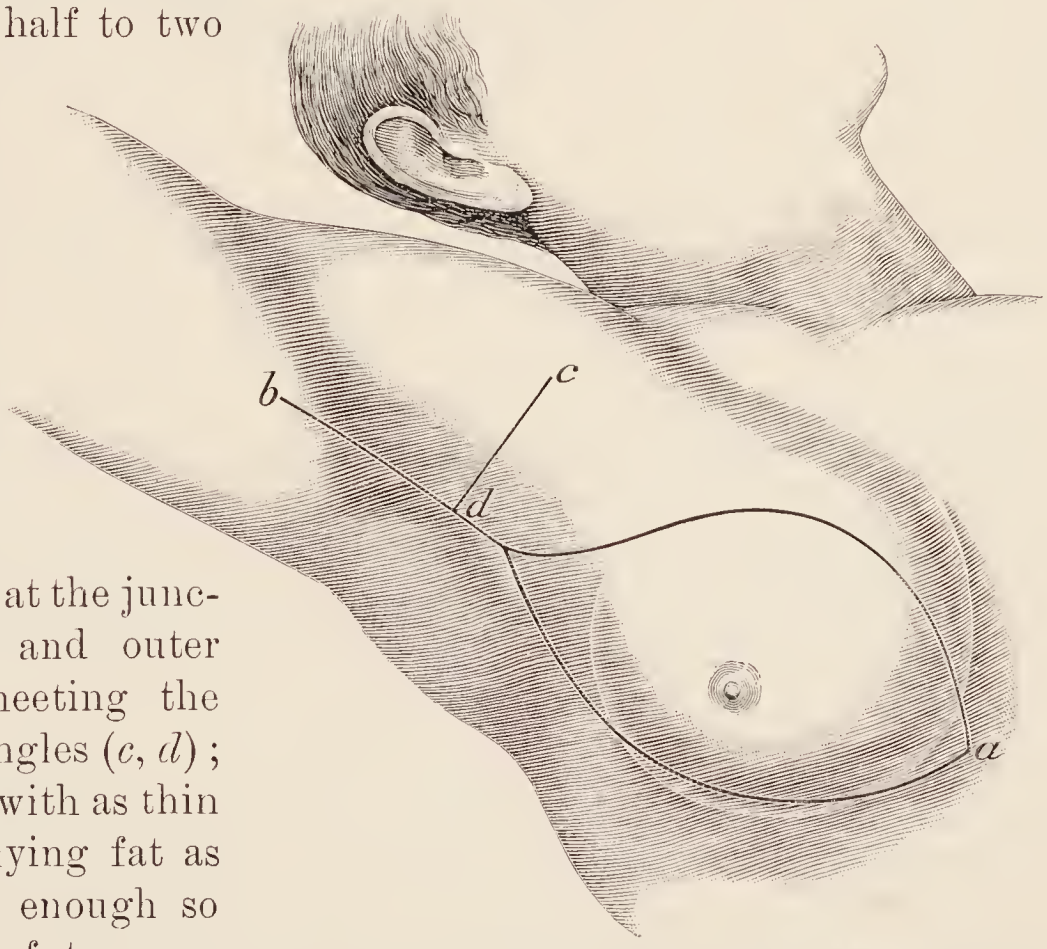



FIG. 1240.—Excision of the breast, Meyer's method. *a*, *d*. Primary incision around breast. *b*. Upper limit of incision. *c*, *d*. Vertical incision from junction of middle and center thirds of clavicle.

the humerus (the raised arm of the patient must be somewhat lowered for this purpose), and separate the same to its insertion into the clavicle. Cut it off at once down to the sternal extremity of the bone, in order to thoroughly expose the contents of the axillary cavity and the infraclavicular and subclavicular region. During this time an assistant exerts some traction on the breast to put the tissues on the stretch; excise the subclavicular, infraclavicular, and axillary fat, glands, and lymphatics, with the knife, beginning over the bundle of nerves and vessels high up in the cavity, and continuing downward from the lower border of the subclavian and axillary vein. As soon as freed, these contents, having been divided on the outer side from the fat in the upper part of the sulcus bicipitalis of the arm, are raised and cut out from the outer side inward, beginning at the border of the latissimus dorsi muscle. This excision is continued, including the fat on the subscapularis and teres major muscles, until the chest walls—viz., ribs, intercostal, and part of the serratus magnus muscles—are plainly seen, and until the 'lower' surface of the pectoral muscles is reached. Fat with glands and lymphatics are nowhere cut into, but remain in one piece, and are attached to the outer lower border of the pectoral muscles in their normal anatomical relation. Divide the tendon of the pectoralis minor muscle at the coracoid process; cause the assistant to gently elevate the breast and muscles, in order to put the blood-vessels, which enter and leave the pectoralis major muscle, on the stretch. As mentioned above, these are clamped before they are divided. Amputate the pectoralis major muscle at its attachment to the sternal extremity of the clavicle, and both muscles at their insertions to the ribs and sternum close to the bones. These portions form the pedicle of the whole mass, and when divided the extirpation of the cancer is complete. Suture the wound as far as possible, using plate sutures for the sake of better coaptation; drain the axillary cavity as usual. The large defect is always to be covered with rubber tissue in order to favor rapid healing under the moist blood clot."

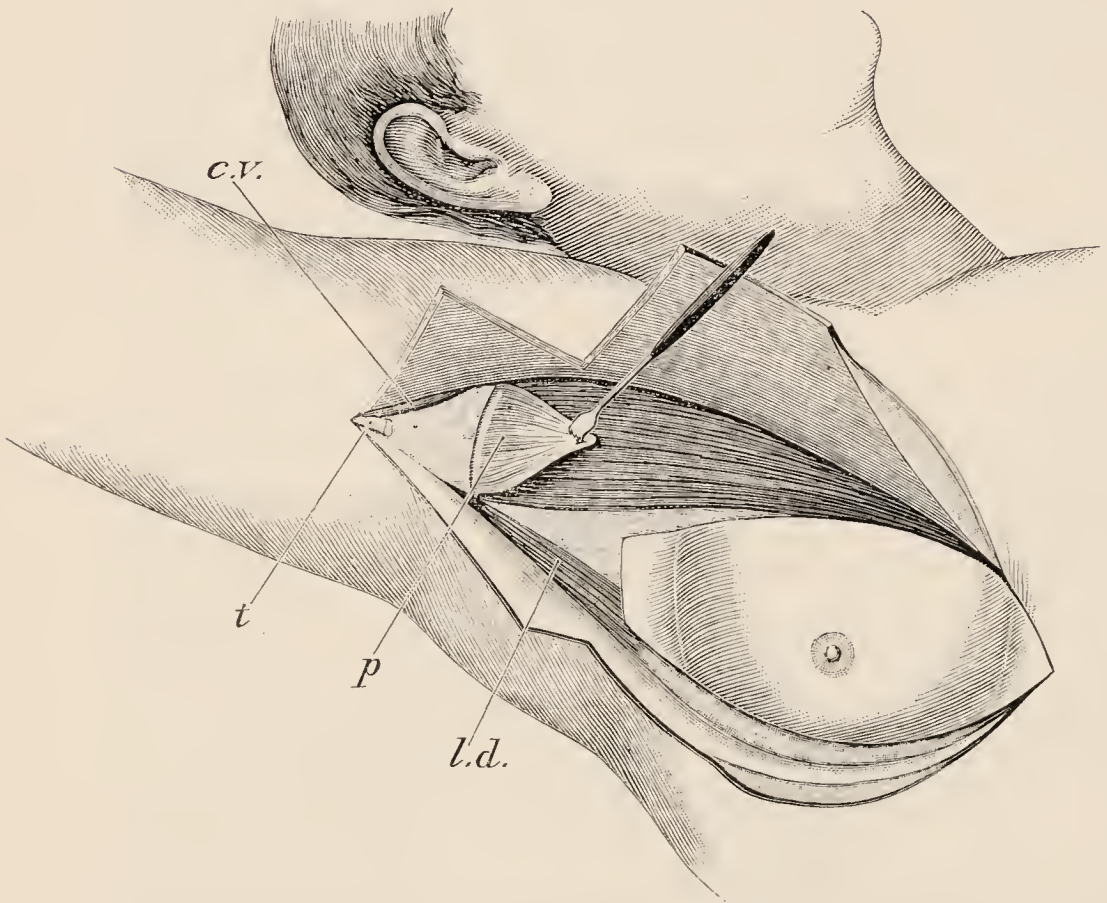



FIG. 1241.—Excision of the breast, Meyer's method. *p.* Pectoralis major muscle. *t.* Tendon of pectoralis major muscle. *c.v.* Cephalic vein in Mohrenheim's space. *l.d.* Latissimus dorsi muscle.

*The Precautions.*—In order that no chance of cancer infection of a

wound can happen during operation, infected glands and lymphatics should be removed without division when possible. And, if divided, they should be wrapped in gauze at once, and the wound freely douched to wash away the possible contamination. Healthy tissue should not be incised with a knife contaminated by contact with malignant tissue until after a thorough cleansing of the instrument. Free handling of a cancerous growth should not be succeeded by manual contact of fresh wound surfaces with unwashed hands. The removal of malignant extension should be done from outside of the diseased area, and not from within it, from motives of safety. Tearing and blunt dissection of the infected tissues should be avoided, and keen division with a sharp knife practiced for apparent reasons. The maintenance of the integrity of the clavicular portion of the pectoral muscle is usually feasible in thorough operative procedure, and is essential to the practical use of the arm in the absence of the sternal part of the muscles. A protracted fixation of the limb in one position, or the construction of a shallow axilla, contribute greatly to impeded movements of the extremity. Enlarged glands located within the area influenced by the growth should be sought for and removed along with contiguous connective tissues. The supraclavicular and infraclavicular spaces should not escape attention, and may be wisely divested of their lymphatic structures in many cases, irrespective of the presence of evidences of infection.

*The Remarks.*—Mammary cancers of the smallest size may have caused already lymphatic and muscular infection. Axillary lymphatic glands may have become infected without the occurrence of appreciable enlargement therefrom. In malignant involvement of the fascia covering the pectoral muscle the muscle itself may be free from the disease, as the lymphatic systems of these structures do not communicate freely in the majority of instances. However, the effect of non-muscular involvement should not be assumed; it should be a matter of established surety.

"A tumor, however freely movable on the underlying parts, has almost certainly advanced as far as the surface of the muscle" (Heidenhain). "The efficiency of an operation is measured truer in terms of local recurrence than of ultimate cure" (Halsted). Any deficiency in the integumentary flap that may follow a special plan of treatment, or of a wide removal of the disease, can be repaired at once, or later by Thiersch's method of skin grafting.

The recognized inability to remove entirely the disease contraindicates any method of attempt, unless it be done to improve the morale of the patient or to secure euthanasia. If a breast be affected with malignant disease, the entire organ should be removed at once.

It is important to note that the margin of the normal breast extends much beyond the limits determined by palpation—a fact especially noticeable in the removal of virgin breasts and those freely clad with adipose tissue. The tissues contiguous to the axillary vein and those at the inner aspect of the apex of the axilla are the most frequent seats of malignant infection, and next in order is the fatty tissue behind the vessels, thence upward to the posterior portion of the subclavian triangle. The condition

of the glands lying between the pectoral muscles and those associated with the vein as it lies contiguous to the first rib, especially the latter, are a fair index of the condition of those beyond. In 1880 *Gross* expressed the opinion that supraclavicular lymph nodes were infected in 6.25 per cent of the instances of axillary node involvement. *Halsted* has demonstrated by microscopical examination of the tissues removed from this space that infection is present in the lymph nodes in 34 per cent of the instances.

**The operative technique of the less radical methods of procedure** is fairly represented in the following statement:

*The Operation.*—Make an elliptical incision through the skin and fascia from a point opposite the center of the axilla (Fig. 1242) downward parallel with the anterior fold, ending just beyond the mamma, of sufficient width to provide an ample amount of sound integument at either side of the morbid growth; divide the tissues beneath the upper incision down to the pectoral muscle, while the assistant draws upward the integument and the operator presses downward the breast, so that it is forced well out of the way; turn the breast downward and expose the pectoral muscle by blunt and sharp dissection, closing the bleeding points by forcipressure; place between the separated structures an aseptic towel; divide the tissues beneath the lower incision as carefully as were those of the upper, while converse force is being exercised; raise the growth and sever the remaining inferior connections, catching the bleeding points as they appear; dissect away the overlying pectoral fascia and such portions of the muscle as are diseased; introduce the finger through the upper end of the incision into the axilla, and search for enlarged glands, especially along the course of the anterior axillary chain of lymphatics; expose at the upper end of the incision the axillary vein; raise upward the pectoral muscle, and remove by blunt dissection inward and downward with the finger the diseased glands and contiguous connective tissue, removing if practicable the entire mass at once (Fig. 1243); tie the bleeding points with catgut; establish drainage openings at the dependent parts; irrigate the wound with an antiseptic solution; dry it carefully with gauze pressure; introduce the sutures first at the upper and lower ends of the wound (Fig. 1244); later introduce the drainage tube and the sutures of the middle part of the wound by means of a short free incision or puncture; adjust the borders of the wound carefully, and tie the sutures throughout, following up the line of

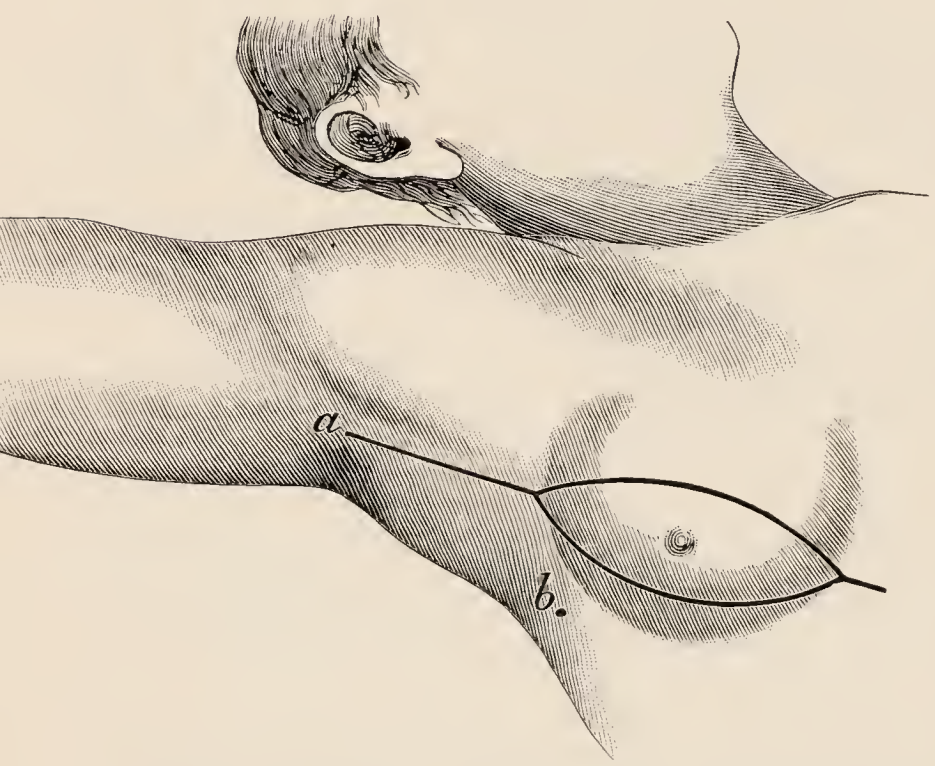



FIG. 1242.—Excision of the breast, so-called conservative method. *a*. Lines of primary incision. *b*. Drainage opening.

tying with continuous sponge pressure; remove the sponges in the order of application, and dust the line of union with iodoform, covering it with a broad strip of iodoform gauze; reapply for pressure purposes along the line of the wound fresh sponges, or elastic gauze dressing instead; carry the arm across the chest at about a right angle, keeping the elbow at the side, or place the hand on the opposite shoulder, carefully introducing beneath the limb for the entire length sufficient dressing to obliterate completely the wound, and comfortably pad the parts without constriction of the circulation; raise the patient into the sitting posture, if practicable, and bandage the arm to the body, carefully noting the influence of the bandaging on the radial pulsations; secure the bandage in place with numerous safety pins, return the patient to bed, and leave in as comfortable a position as practicable.

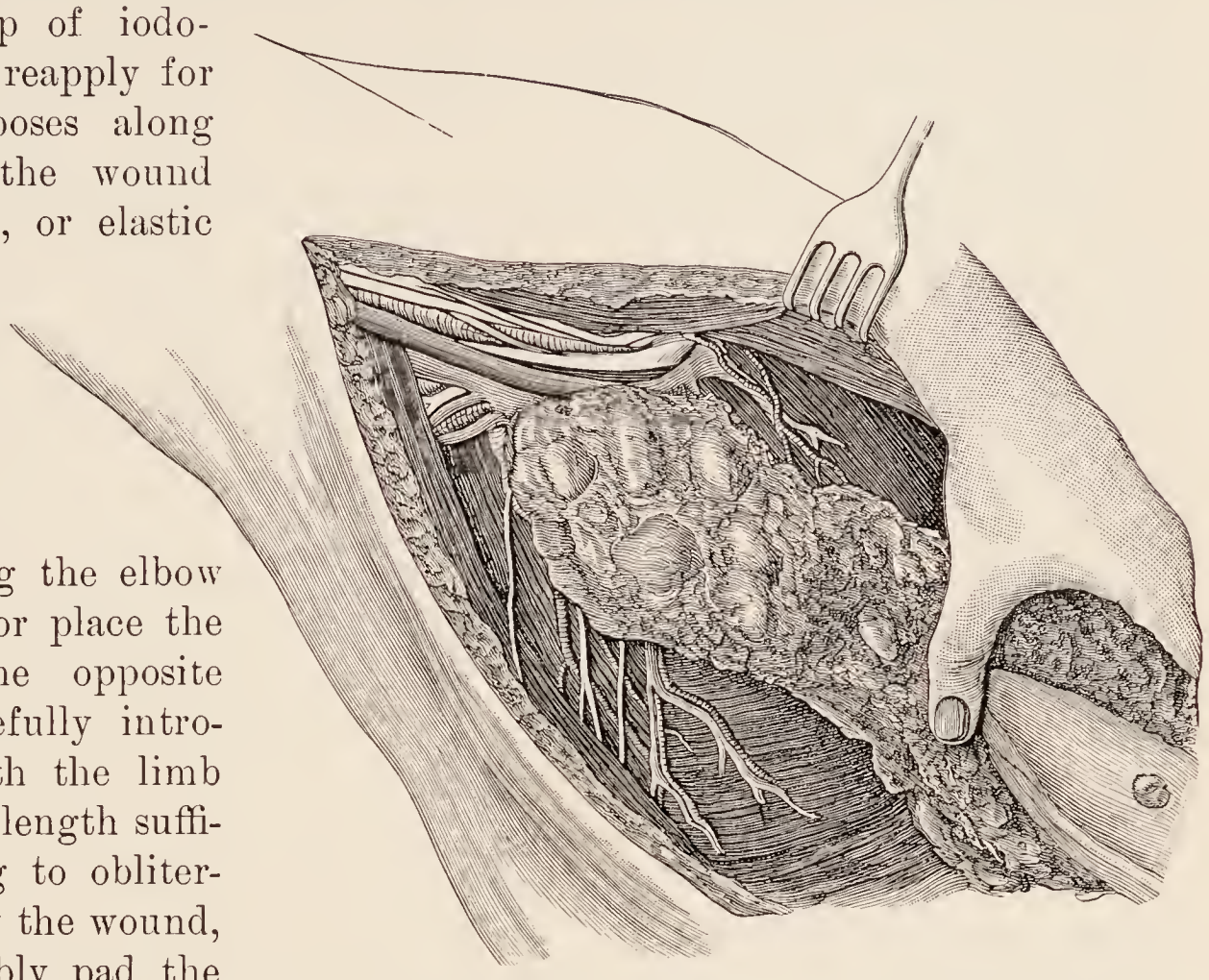


FIG. 1243.—Excision of the breast, so-called conservative method. Removal of diseased mass.

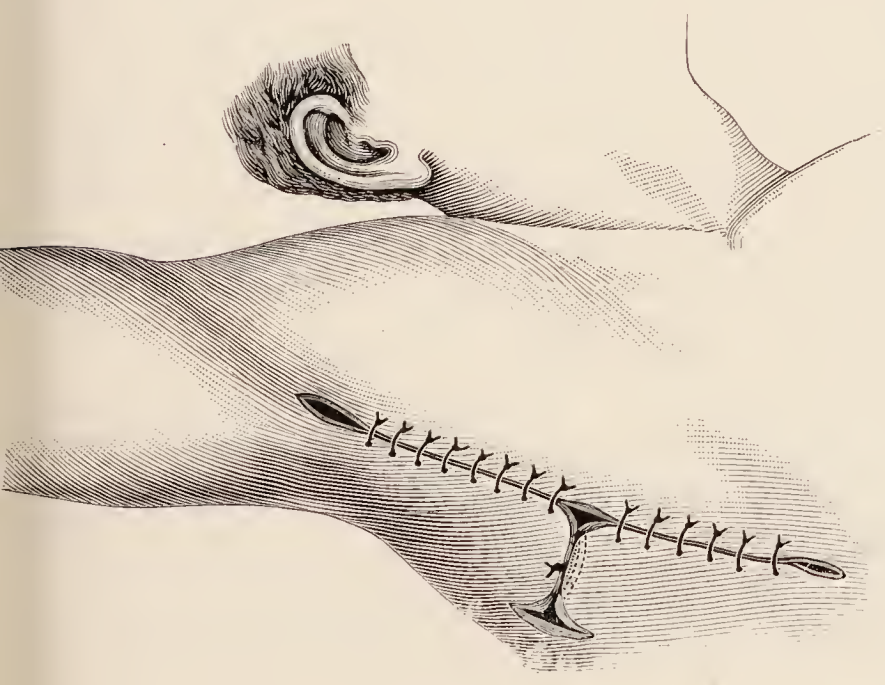


FIG. 1244.—Excision of the breast, so-called conservative method. Drainage openings indicated.

The confinement of the arm at a right angle with the chest after operation for cancer of the breast, to avoid the immobility that often follows confinement at the side, is approved by Cheyne. *Dowd* has devised a jacket to support the dressings, without confinement of the extremity, which he regards with great favor.

*The Precautions.*—The removal of apparently diseased tissue from within the area of surgical scope in the conservative method of practice should be thoroughly done, and prospective sites of malignancy removed in the more radical methods of action.

*The General Remarks.*—The security of the axillary vein and the promptness of surgical dispatch in the removal of diseased structures from the axilla are sometimes greatly facilitated by primary exposure of the vein at the outer limit, followed by dissection and separation inward along the vessels to the center of the axilla.

The lower incision may be made first, thus avoiding the annoyance and obscuration caused by the flow of blood from a primary upper incision. If the axillary vein be involved, the diseased portion should be removed between two ligatures. The subscapular vein often requires tying—a fact of no special significance. Proper observation and complete and safe removal of the diseased nodes at the apex of the axilla require division of the pectoral muscles, which may be thereafter removed or repaired by sewing, as circumstances demand.

A free incision made in the long axis of the clavicle, or the turning upward of a flap limited by the posterior border of the sterno-mastoid muscle of sufficient size to expose the glands in the supraclavicular space, can be employed. The latter is better calculated to meet the full requirements of the procedure.

When practicable, the skin incision for removal of the breast may be so planned as to secure proper apposition of the margins of the wound. The influence of traction sutures, inserted far away from the margin of the wound and tied, is of decided importance in securing coaptation of the borders in instances of scant integumentary flaps.

*Treves* advises that the arm be abducted and the hand placed behind the head, and held there by the anæsthetist during the operation. The axilla should be shaven closely, so as to avoid as much as possible the irritation incident to growing hairs during recovery. All bleeding points should be tied with fine strong catgut, to avoid the oozing that may follow a less secure means of closure. The wound should be cleansed by douching, and dried by compression with gauze or sponges, and not wiped by either. Careful obliteration of the entire wound by gauze or sponge pressure should be secured, to avoid the presence of dead spaces. A return of the disease in the line of operative procedure can not be disregarded, as it strongly emphasizes the facts of incomplete removal and defective technique.

*Amputation at the extremity* for removal of cancerous disease of the axilla can not be commended as a means of cure. In cases amenable to this plan the disease has no doubt extended so far beyond the axilla as to forbid the amputation with the expectation of final relief. However, in instances where excessive pain from brachial plexus involvement torments the patient, the expediency of amputation may then be entertained for the purposes of euthanasia.

*The after-treatment* consists largely in attending to the comfort of the patient. The wound should be redressed on the third day and the drainage agent removed if employed, unless soiling of the dressings or unexpected happenings call for prompter action. Thereafter the dressing is not changed for five or six days, and perhaps longer in many cases. The sutures are removed in a week or ten days, and the arm is liberated at about the same

time. The patient is ordered out of bed during the second week usually, and should be around a few days later. Early movement of the limb is advisable, to remedy as promptly as possible any restricted motion that may ensue. A careful scrutiny of the patient should be practiced at intervals of six or eight weeks for a long time, to detect the earliest manifestations of a recurrence. Prompt, wide, and repeated removal should follow successive manifestations, when practicable.

*The Results.*—The death rate (about 2 per cent) from the operation alone, when performed with aseptic care, according to any established method, does not contraindicate the measure in operable cases. Inasmuch as the deltoid and coraco-brachialis muscles assist the pectoral muscle in drawing the arm forward and inward, the removal of the greater portion of the latter, while not lessening materially the range of movements of the arm, does diminish decidedly the power of these movements. Other things being equal, the frequency of the recurrence and the brevity of the period of local return are the proper measures of the value of an operation for the eradication of malignant disease. In 1889 *Williams*, from the experience of the Middlesex Hospital, stated, according to Treves, that "the average duration of life, dating from the time the disease was first noticed, is 60.8 months for those who undergo operation, and 44.8 months for those in whom the disease runs its natural course. The average duration of life subsequent to amputation of the breast is 40.3 months. The average interval between the first operation and the first recurrence is 26 months; the maximum, 130 months; the minimum, 2.5 months." *Warren's* experience places the mortality rate at 2 per cent, and 40 per cent as alive and well at the end of three years. *Cheyne* reports that in 99 unselected cases 56 were free from disease from one to nine years, also that in 61 of the 99, 30 were free from recurrence at the end of three years.

In 1894 *Halsted* published the outcome of fifty cases operated on by himself since June, 1889, and estimated along the same lines of consideration as those of similar reports published elsewhere, especially by eminent German surgeons. The results attracted marked attention on account of the comparatively high degree of success which they exhibited, and the direct relation that it seemed to bear to the logic of extensive and thorough operative technique. However, since many of the cases had not then reached the three-year limit of cure, an announcement of the final result was awaited with deep interest by thoughtful surgeons. *Halsted* has recently announced that over 52 per cent of his patients have lived more than three years after operation without local return or metastasis.

The general average of trustworthy reports based on the three-year limit show a rate of cure of about 40 per cent.

Only the results of the general average of stated methods of operation are considered, because the announcement of improved results in a limited number of cases without definite expression as to the technique employed should be regarded as being of a greater personal interest than of scientific importance.

*The Choice of Operation.*—We employ the radical method whenever prac-

ticable, and, in our opinion, little remains to be said regarding this matter from the standpoint of surgical expediency. The average standard of attainment of the older and less radical methods appears to have reached already its highest altitude. The advent of the newer, a radical and more logical plan of action, with a much greater percentage of achievement, and without proportional danger, begets renewed hope, which should be sustained by like surgical endeavor until the true value of the measure is established. A radical operation is indicated in all cases in which general infection has not occurred, and local manifestations, together with the prospective sites of malignant advance, admit of complete removal without immediately exposing to unusual danger the life of the patient.

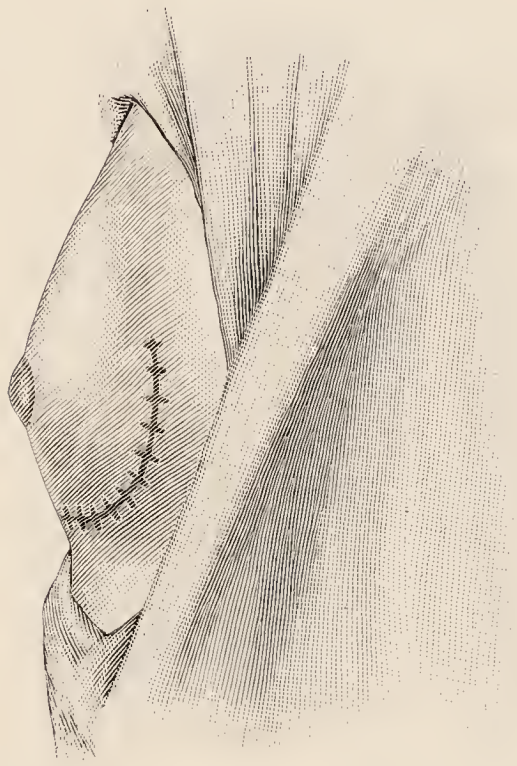


Fig. 1245.—Excision of the mammary gland. Thomas's method.

**Non-malignant Tumors.**—In the removal of non-malignant tumors from the breast the incisions should be so formed as to cause the least possible final disfigurement or interference with the function of the organ. The nipple is the most essential feature, and should be preserved when possible.

The pectoral border of the axillary fold can be pulled toward the median line of the body, and the breast removed through an incision corresponding with the direction of the fold, and the return of the tissues to the natural site will hide the cicatrix and present an undisfigured surface to view.

**Thomas's Method.**—*Thomas* carried around the lower margin of the breast in the line of the mammary fold an incision of sufficient length and depth to permit the easy turning upward of the organ (Fig. 1245). The diseased portion of the gland was then removed from beneath without involvement of the integument above, the breast returned to the normal position, and the divided borders were united with sutures. In these instances the nipple can usually be saved, and recovery takes place with a minimum degree of scarring. We have practiced this method in several instances with entire success.

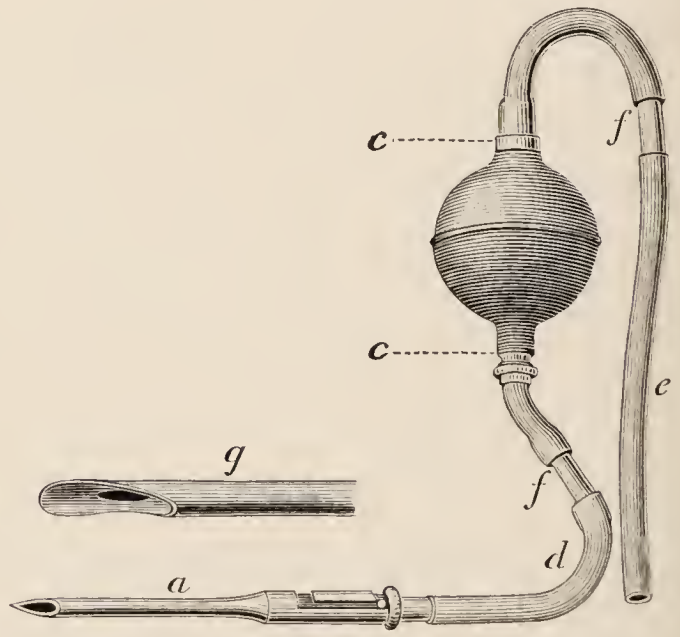



Fig. 1246.—Thoracentesis. Fitch's aspirator. *a*. Trocar. *g*. Cannula. *c*, *c*. Couplings. *e*. Rubber tube. *f*. *f*. Glass tube sections.

**Thoracentesis.**—The tapping of the pleural cavity for the relief of pleural effusions especially and of hydrothorax is a common procedure (Figs. 1091

and 1093). The aspirator with the trocar and cannula attachment is better than the needle alone, as the latter may inflict injury on the lung tissue, especially during the withdrawal of the fluid (Fig. 1246).

*The Anatomical Points.*—The intercostal vessels and nerves run along the contiguous borders of the ribs, sheltered somewhat, especially at the posterior halves, by the grooved arrangement of their lower borders. The attachments to the walls of the thorax, of the diaphragm, and the influence on its relations to the thoracic contents of the respiratory acts, are often important in this operation, and therefore the consulting of a standard work on anatomy in this regard may not be amiss. The intercostal spaces, especially at the accepted points of puncture, are easily and safely penetrated.

*The Operation.*—The sixth intercostal space in the midaxillary and the eighth in the scapular lines are the sites usually selected for the puncture. Place the patient on the back with the afflicted side at the edge of the bed; raise the arm out of the way; cleanse the part thoroughly and draw the skin upward at the seat of attack and hold it with the thumb and fingers; cocainize the part and then puncture the skin near to the upper edge of the lower rib of the chosen space with a narrow knife; thrust into the puncture the trocar or needle inward and upward through the pleura limiting the extent of penetration by the finger; draw off the fluid slowly, regulating the flow by the symptoms of the patient. If blood appear, withdraw the needle at once. The wound is closed and sealed with collodion.

*The Precautions.*—Before tapping is performed, the nature of the fluid and the proper seat of the puncture should be determined by the agency of a hypodermic syringe. In tapping be sure to enter the chest cavity and to avoid at the same time the lung. With a limited collection of fluid the latter may be easily injured, unless wise forethought be exercised. The fluid should be withdrawn slowly, as rapid escape may cause syncope, œdema of the lung, and other disagreeable and perhaps dangerous manifestations. The withdrawal should cease in such instances and not be resumed until after suitable restoration is established. The integument should be drawn upward at the seat of proposed puncture to a degree proportionate to the distention of the chest by the fluid, in order that the skin puncture may conform to that of the wall after the latter is lowered following relief from the distention. Especially is this important in the instance of empyema when permanent and well-directed drainage is needed. The point of the needle will impinge on the rib unless care be exercised, especially if the intercostal space be narrowed. The lower the seat of puncture the greater should be the upward direction of the needle to avoid the diaphragm. If the tube becomes blocked, reverse the current or remove the obstruction with a stylet. If, before insertion, the needle be passed through a thin piece of firm rubber, the rubber will be pushed along the needle by the insertion, and accurately mark the distance to the pus, on withdrawal of the puncturing agent.

*The Remarks.*—A general anæsthetic is rarely admissible. The sudden appearance of blood in the fluid may depend either on rupture of the vascular adhesions, perhaps wound of the lung and possibly of a vessel of the thoracic wall. Violent cough not infrequently attends the flow, due to un-

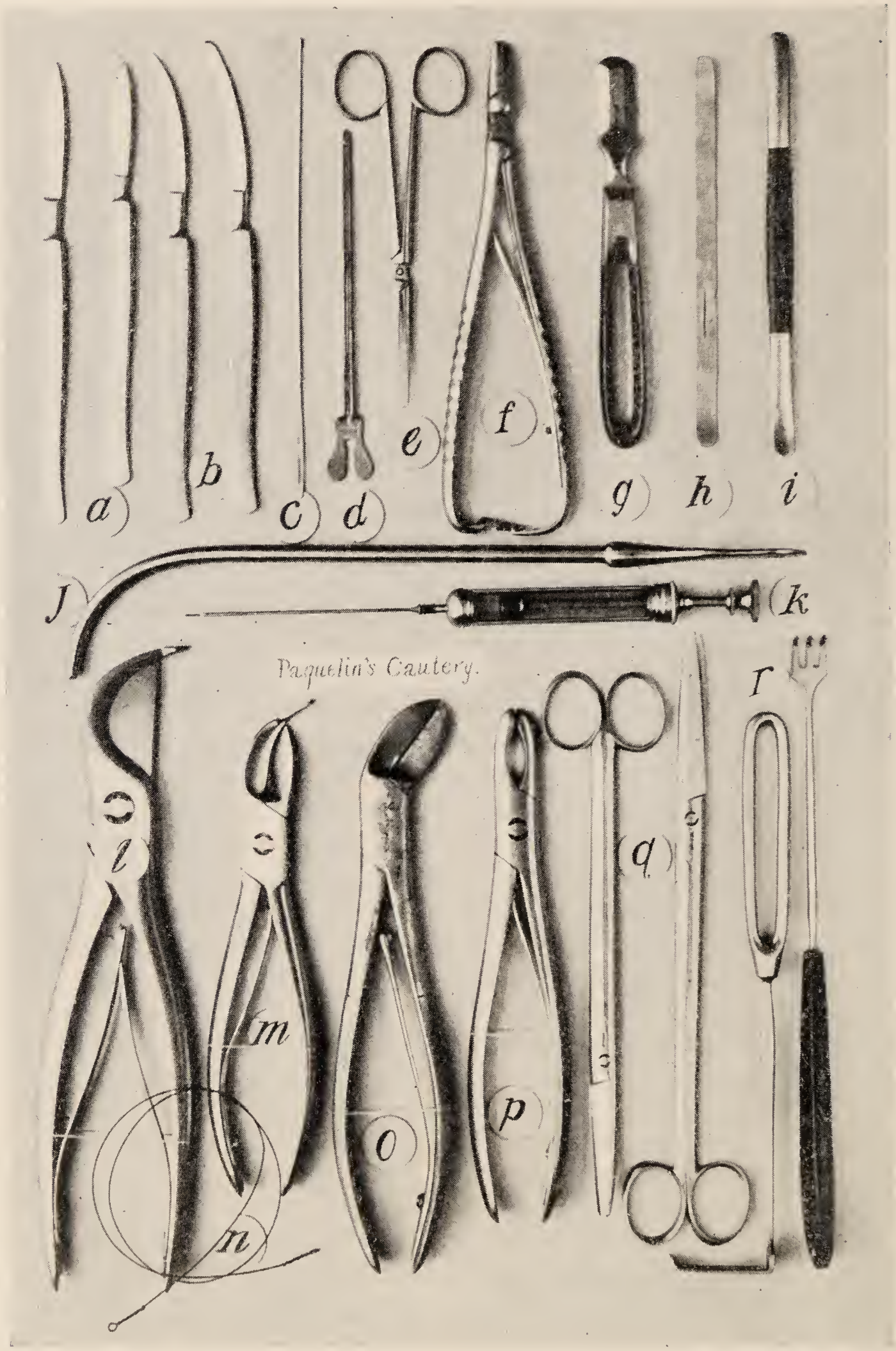



Fig. 1247.—Instruments employed in operations on the chest wall and the pericardium.

*a*. Large and small scalpels. *b*. Probe and blunt-pointed bistouries. *c*. Silver probe. *d*. Grooved director. *e*. Sinus forceps. *f*. Needle holder. *g*. Rugine. *h*. Spatula. *i*. Periosteal elevator. *j*. Steel sound. *k*. Aspirating syringe. *l*. St. John's costotome. *m*. Beck's costotome. *n*. Gigli-Haertel saw. *o*. Angular bone-cutting forceps. *p*. Rongeur. *q*. Long blunt scissors, straight, and curved on the flat. *r*. Blunt and hooked retractors. Forcipressure, thumb and mouse-toothed forceps, ligatures, suturing needles, drainage tubes, wipes, etc., are required. An electric light may be needed.

folding of the compressed lung, and during the attack the end of the instrument should be directed as far as possible away from the lung. The puncturing agent should be of sufficient size to permit the free escape of the fluid, and even then the lodgment of the end in a caseous mass may mislead the operators, unless the obstruction be pushed aside or its presence determined by a probe carried through the lumen of the instrument.

*The evacuation of pus* by this method of practice can not be regarded as curative in chronic and tubercular cases, and at best should be employed only as a temporary expedient to meet urgent demands. The very young, and those much enfeebled, and in whom rapid and large collections of pus are present, may be more satisfactorily and safely treated by a preliminary operation of this character.

*The Results.*—In acute cases in children with pneumonia, about 20 per cent are cured (Holt).

**Thoracotomy.**—The operation of thoracotomy is usually limited to the removal of a portion of one or two ribs, for the purpose of evacuating the pleural cavity of pus or blood, and for the removal of diseased processes of the chest wall and lung (Fig. 1248).

*The Excision of a Portion of a Rib for Empyema.*—It seems proper to note in this connection that collections of pus in the pleural cavity are frequently localized, and even multiple collections sometimes are present. This plan of action is especially valuable in cases with foul discharge and in those of a chronic nature with and without contraction of the chest wall. The operation is, however, severer than that of simple incision, and therefore in the feeble and very young it should be selected with discretion.

*The Operation.*—After proper stimulation and thorough antiseptic precautions, place the patient on the back with the affected side at the edge of the table; employ local or general anæsthesia, as the condition of the patient requires; select the sixth or seventh rib; make an incision in a line of the axilla about two or three inches in length down upon the middle of the rib (Fig. 1248) in the long axis, through the periosteum; bisect the primary incision at the center with a horizontal one the width of the rib; raise from the bone on both surfaces (Fig. 1249) with a periosteotome the periosteum together with its surrounding tissues, being careful not to open into the pleural cavity; exsect an inch or an inch and a half of the bone, dividing it with a Gigli-Haertel saw (Fig. 1247, *n*) or rib forceps; arrest hæmorrhage and then make a suitable opening through the intervening structures into the pleural cavity (Fig. 1250), and permit the fluid to escape without special interference.

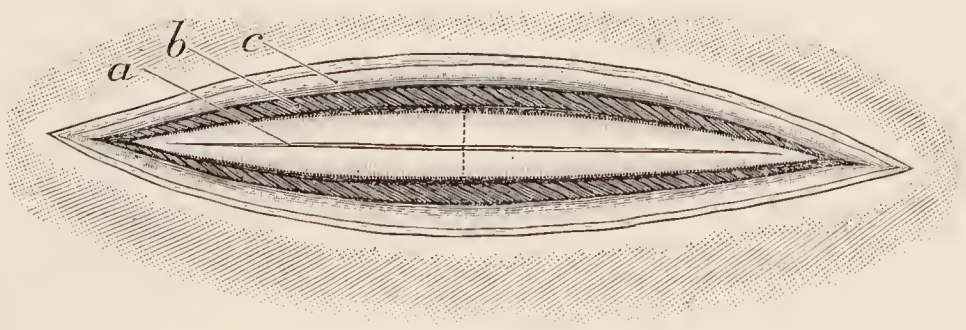



FIG. 1248.—The operation of thoracotomy, removal of segment of rib. *a*. Incision through periosteum of rib. *b*. Intercostal muscle. *c*. Superficial tissues, dotted line indicates transverse incision of periosteum.

*The Precautions.*—Avoid division of the intercostal vessels, for obvious reasons. Irrigation is dangerous and ought not to be practiced except cautiously, and then only for the relief of foul discharges. The use of peroxide of hydrogen should be avoided in every instance; normal saline and boric-acid solutions are the best for the purpose. Submersion of the patient in a warm saline bath affords an easy, comforting, and effective method of washing out the cavity. The precautions of thoracentesis for hydrothorax are pertinent in this procedure. If the opening be made too low, the ascent of the diaphragm will obstruct and possibly may close it. If too high the angle of the scapula will obstruct the opening. The lymph masses may be loosened by introduction of the finger or a sound, and removed with forceps whenever they obstruct the opening. The drainage tube should be incompressible, should just reach the pleural cavity, and be fastened so that it can not escape within. Sometimes two are employed (Fig. 1251) side by side, especially when washing of the cavity is practiced during healing, the fluid entering one and escaping by the other. If the tube happens to rest upon an intercostal nerve severe pain, referable to the distribution of the nerve, often occurs. The fluid should be permitted to escape slowly and ought to be temporarily arrested in case of severe coughing. If hæmorrhage happen into the pleural cavity, the tube should be introduced, the wound dressed, and the patient placed on the diseased side at once.

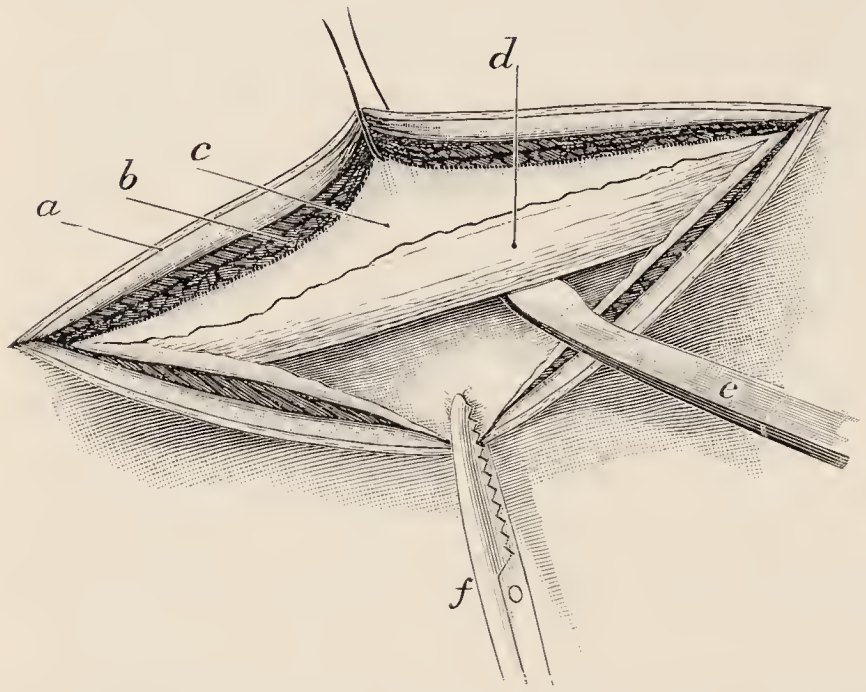



Fig. 1249.—The operation of thoracotomy, removing periosteum from rib. *a.* Integument and subcutaneous tissues. *b.* Intercostal muscles. *c.* Periosteum. *d.* The rib. *e.* Periosteotome. *f.* Forceps.

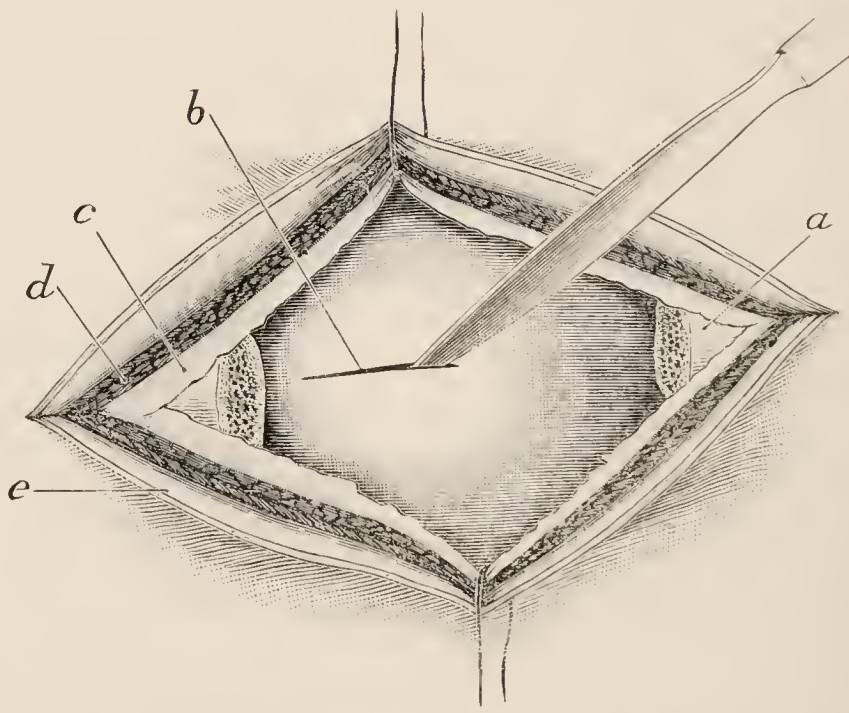



Fig. 1250.—Opening into the pleural cavity. *a.* Divided end of rib. *b.* The pleura. *c.* Periosteum. *d.* Muscular tissue. *e.* Integument and subcutaneous tissues.

*The Remarks.*—It is wise that a bacteriological examination of the pus be made, to determine, as far as possible, the nature of the process. The drainage tubes should not be so long as to impinge on the lung, and ought to be shortened as the cavity contracts.

*The After-treatment.*—Antiseptic dressing should be applied liberally to the seat of the operation, and changed frequently to avoid infection. The patient should be kept quiet, and indications of treatment met as they arise. A sinus formation may be irrigated and generally treated as in other parts of the body. Gymnastic exercise and efforts directed to the prevention of contraction of the chest should be practiced.

If for removal of diseased bone, make an incision at the middle of the long axis of the rib (Fig. 1248) of sufficient length to include the diseased portion. Supplement this one at the center by a transverse incision. Separate the periosteum along with the superimposed tissues, liberate the bone, and raise it from its bed. If the sequestrum be not loose, time should be allowed for its separation.

**Simple Incision.**—Simple incision with drainage is not now regarded with the same favor as formerly. The narrowness of the opening and its tendency to close and hinder drainage are serious objections in chronic cases, and, moreover, the opportunity for escape of the fibrinous products from the chest and the ability to properly remove them present objectionable features to the use of the method. But in limited collections of pus of an acute nature, and chronic cases in feeble patients, this method, if failing to cure, may often serve an important preliminary purpose. The establishment of the proper seat of the operation and the precautions attending the procedure differ in no essential respect from those of aspiration and of excision of a rib. The incision is made midway between the contiguous borders of the ribs, either in the axillary or subscapular line, as best suits the purpose, always remembering (as in the other operations) to avoid locating it so that the movements of the scapula or diaphragm can interfere with drainage. The incision is cautiously made down upon the pus, instead of entering the collection at once by a sudden thrust. The latter plan is unnecessary and needlessly dangerous. After the escape of the fluid and of the lymph products, drainage is established as in the preceding operations. However, the strong inclination of the opening to close because of the approximation of the ribs requires that the drainage agent shall not infrequently have rigid walls. To meet this indication we have in several instances utilized for the purpose the ordinary large-sized gutta-percha (Fig. 1270, *l*) tracheotomy tube, properly shortened, through which a rubber tube is carried. If the former be heated over an alcohol lamp, it can be cut off or bent in a direction to suit the demands of drainage and of protection to the lung at the same time. The collar of the tube fits closely to the side of the chest and can be held in place by means of an elastic tape fastened around the body. The removal from the upper

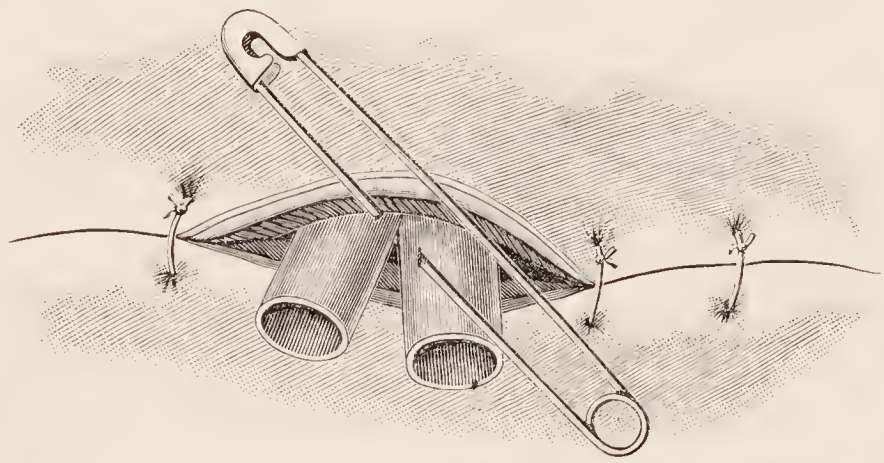


FIG. 1251.—Drainage of cavity with two rubber tubes. Soft parts sutured.

border of the contiguous lower rib with a rongeur of a limited portion of bone sufficient to afford lodgment of the hard- or of a soft-rubber tube prevents pressure, and also obviates the closure of the latter.

*The Remarks.*—One opening is sufficient, and this need not be made at the most dependent part of the collection, as the lung expansion and diaphragmatic ascent expel the pus. The tube should be of fresh rubber at all times and be securely anchored with a safety pin. It should not reach within half an inch or so of the inner wall of the abscess cavity, and the rapidity of the contraction, as ascertained by the introduction of water, should regulate the frequency and amount of the shortening of the tube. The tube should be removed when only a small amount of sero-purulent fluid escapes.

*The Results.*—Incision and drainage and primary excision give different results. The former a death rate of about 33, the latter about 20 per cent. In 467 cases treated by both methods, the average mortality was 26 per cent. The following tabulated statement of 123 cases of empyema in childhood is very instructive:

*Results of Operations of Empyema in Childhood. (Brothers.)*

| | No. of cases. | Recoveries. | Deaths. |
|---|---|---|---|
| Simple aspiration | 9 | 2 | 7 |
| Simple incision with drainage | 98 | 64 | 14 |
| The same after unsuccessful aspiration | 9 | 8 | 1 |
| Primary exsection | 2 | 2 | 0 |
| Secondary exsection | 5 | 5 | 0 |
| | 123 | 81 | 21 |

**Aspiration combined with Drainage.**—Much has been said in the past of aspiration for the purpose of expansion of the lung and drainage in empyema. Potain, Perthes, Bülau, and others devised methods of relief, most of which were impracticable because they were too confining and cumbersome. The writer during the last year devised and applied successfully to the chest of a patient suffering from an extensive traumatic empyema* the following simple and effective apparatus (Fig. 1252): the end of the tube projecting beneath the cushion (*a*) is passed into the empyemic cavity a proper distance, and the cushion (*a*) is

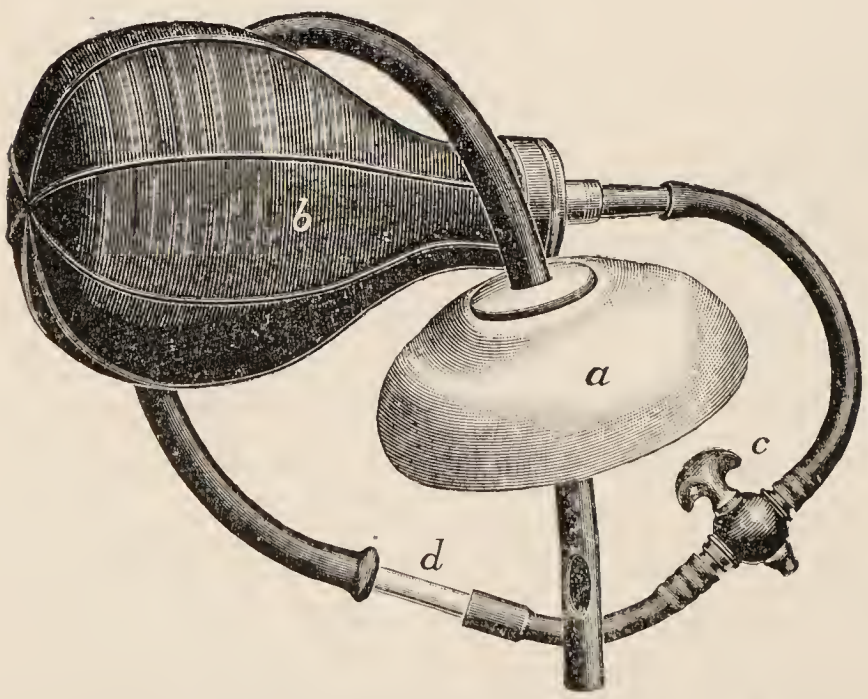



FIG. 1252.—The aspiration apparatus. *a*. Hollow rubber cushion. *b*. Distended rubber bag. *c*. Stopcock. *d*. Glass observation tube.

* From the Jacobi Festschrift.

placed in contact with the wall of the thorax in such a manner as to command equally the area surrounding the opening into the pleural cavity. The nozzle of an ordinary six-ounce rubber syringe is then inserted into the distal end of the tube (Fig. 1253), the liquid withdrawn, followed finally by sufficient exhaustion of the air to cause the rubber cushion to fit closely enough to the chest wall to prevent the passage of air beneath it into the pleural cavity. The stopcock is then closed (Fig. 1254), the syringe removed, and the nozzle of the rubber bag (Fig. 1252, *b*) while fully collapsed is inserted firmly into the open end of the tube (Fig. 1255), the stopcock reversed, thus establishing aspiration, which is maintained so long as the bag is expanding. The chest is then dressed and the apparatus duly fastened in place as indicated in Fig. 1256. The patient can go about comfortably with the apparatus in action without attracting special attention. When the bag is nearly distended, the stopcock should be closed, the bag cleansed, again collapsed, reapplied, and the stopcock opened.

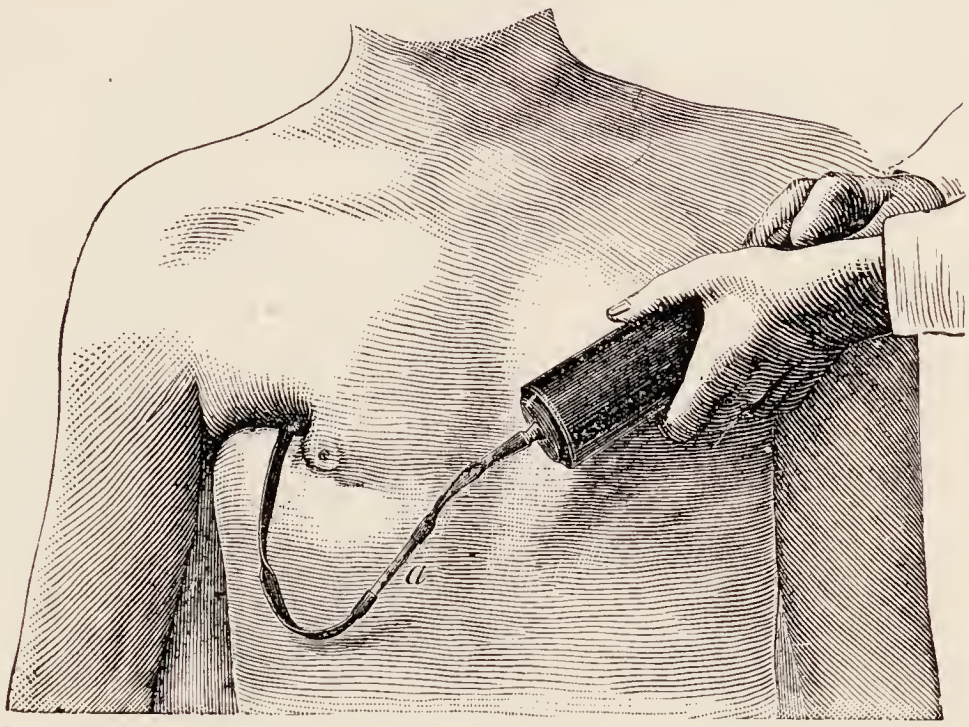



FIG. 1253.—Aspiration of the cavity. *a*. The glass observation tube, showing suction force applied by syringe.

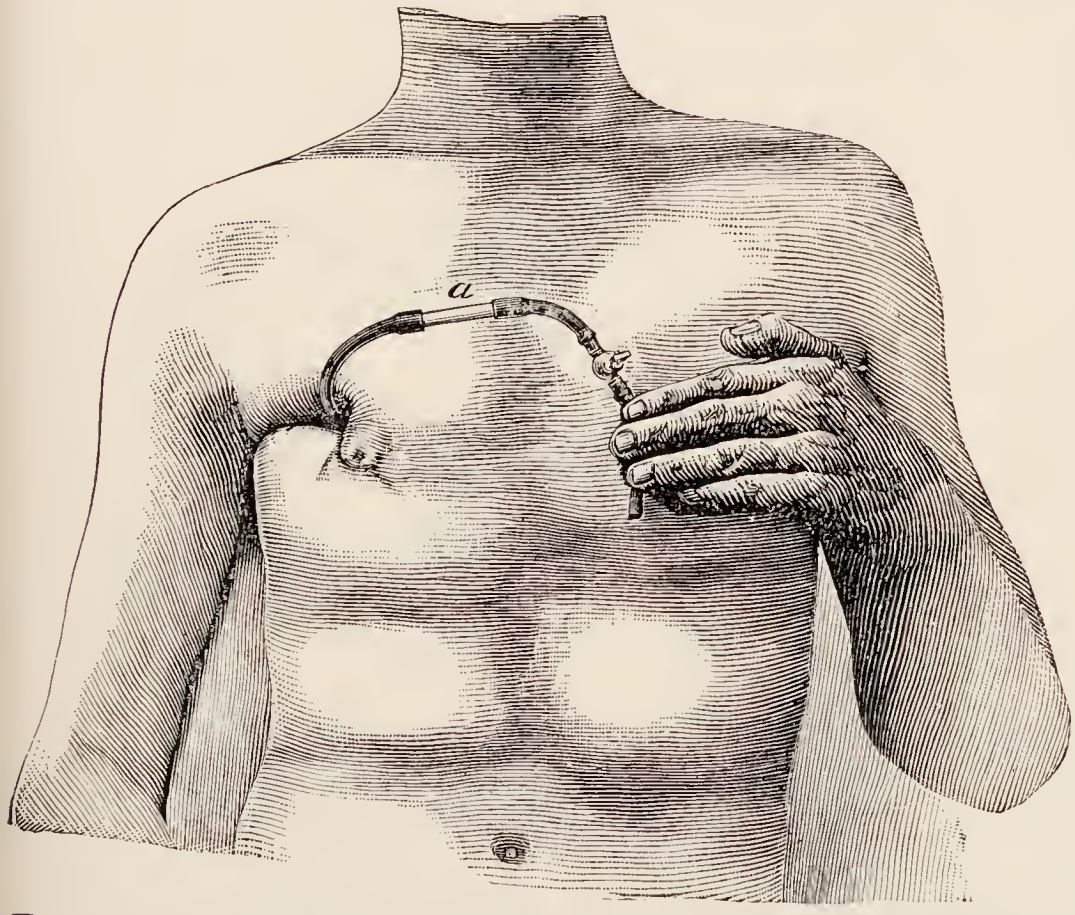



FIG. 1254.—Aspiration of the cavity. *a*. Segment of glass tube. Cavity aspirated and stopcock closed to prevent admission of air.

*The Precautions.*—If brisk and forcible aspiration by the syringe be made, the tube will collapse (Fig. 1253), and often the discharge will be tinged with blood, which can be noted through the glass segment of the tube. Continuous and mild aspiration is safer and quite as effective as the vigorous in the majority of instances. The degree of distention of the bag should be fre-

quently observed in order that it may be removed, cleansed, and reapplied without the interruption of aspiration. Adhesive plaster applied to the chest around the opening aids in the exclusion of air. Absorbent cotton thoroughly wet with a boric-acid solution hinders the passage of air beneath the cushion. It is very important in this connection to remember that the cotton, or any small movable body, may be drawn into the chest unless care be exercised. Should this happen it can be removed quite readily in most instances by moving around in the cavity the inner end of the tube while making suction on the outer with the syringe.

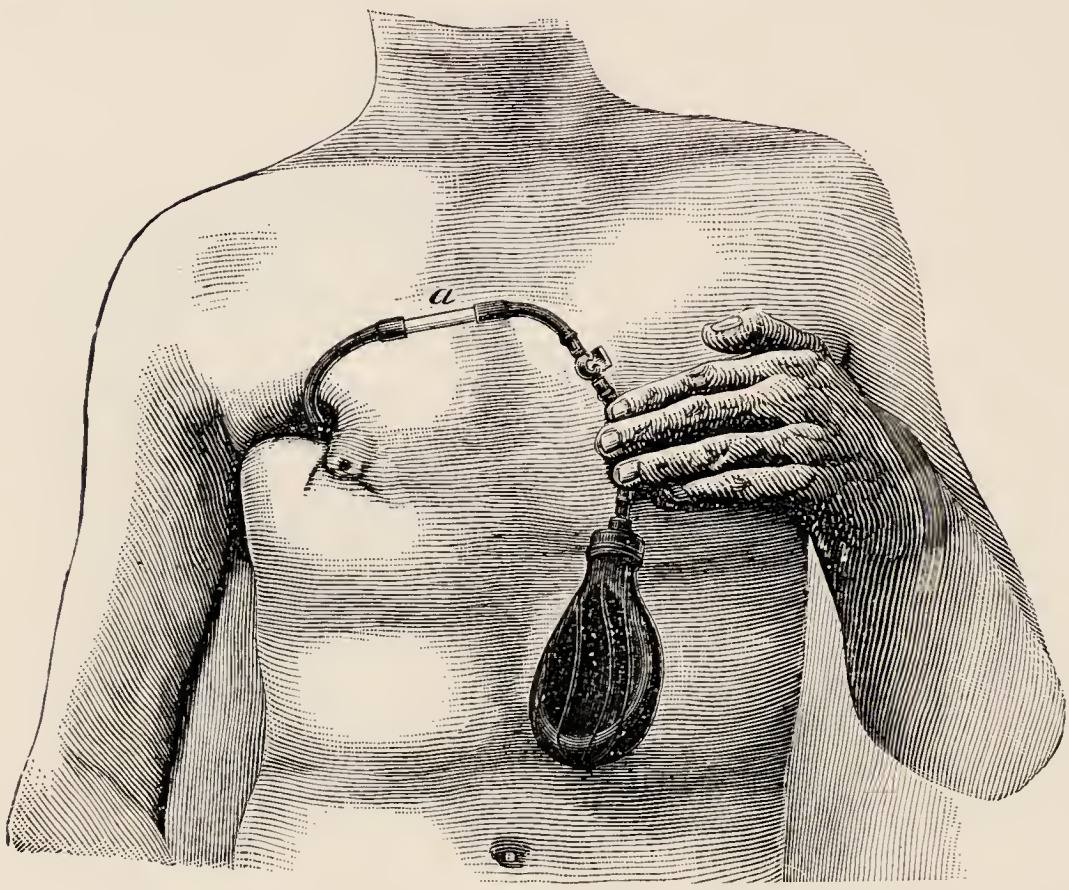



FIG. 1255.—Aspiration of cavity. The collapsed rubber bag attached and stopcock opened; the apparatus in action.

*The Results.*—In the case to which aspiration was applied it acted efficiently and promptly, and was easily managed by the patient.

*Hutton* has devised an ingenious and serviceable apparatus which permits the escape of fluid from and prevents the entrance of air into the pleural cavity during the acts of breathing, coughing, etc. The apparatus consists of a large rubber drainage tube with a flange of sheet rubber five inches long and four inches broad; the tube passes through the middle of the flange. A valve of duckbill form is made by slitting a gutta-percha nipple at the end. The unslit portion of the nipple is connected by means of a glass

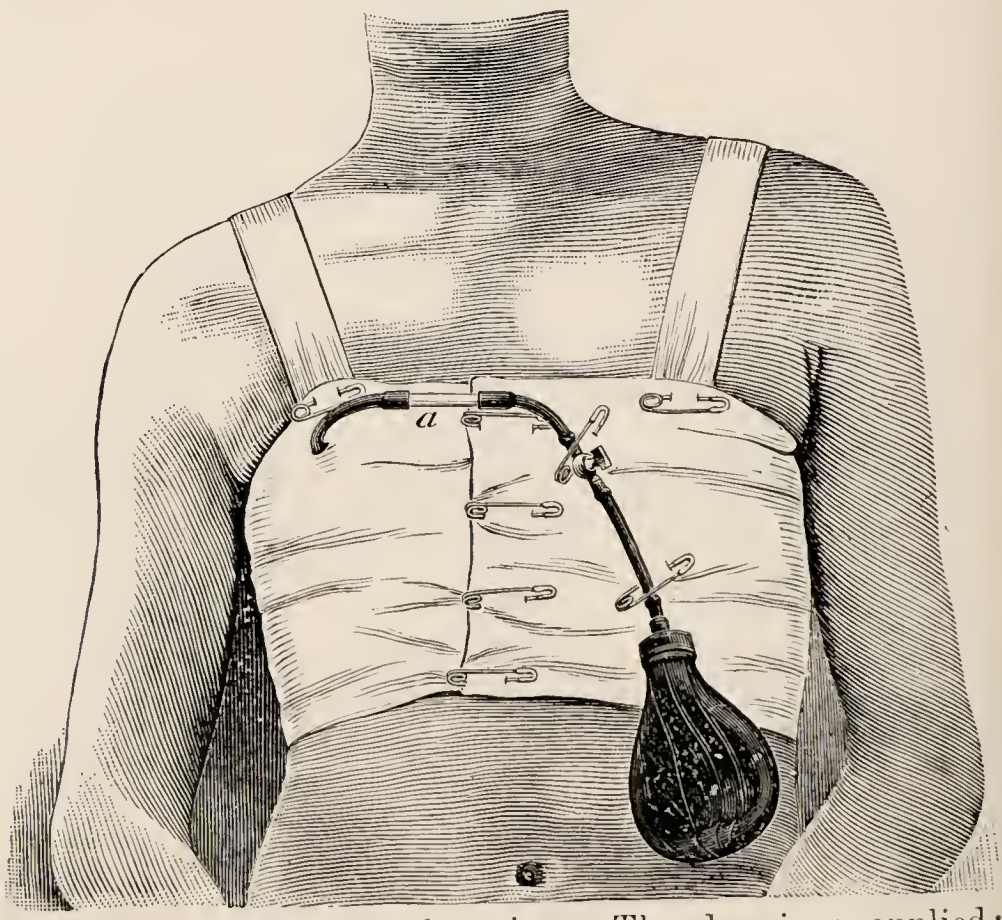



FIG. 1256.—Aspiration of cavity. The dressings applied; apparatus held in place by safety pins while in action.

tube with a short piece of rubber tube, which latter is finally connected with the main tube by means of a right-angled glass one. After the chest is opened the remaining end of the primary tube is cut off near enough to the flange to permit it to extend only through the chest wall. The apparatus is then bound firmly in place, the flange resting upon a large piece of wet gutta-percha tissue to prevent the entrance of air beneath. Hutton speaks in high terms of this device.

It seems to the writer that practicable aspiration offers the opportunity of prompter cure in excision cases, and not impossibly may render needless the serious methods of practice by obviating the conditions that prompt their use. Much contention has arisen in the past regarding its feasibility. The writer notes with regret the seemingly strenuous tenor of these contentions. Cases complicated with gangrene of the lung and abundant fibrinous deposits are certainly unsuited for the immediate use of aspiration treatment.

**Thoracoplasty.**—*Estländer's Operation.*—The operative practice associated with the name of Estländer is applicable to the long-standing cases of empyema, in which the powers of a natural cure are inadequate for the purpose, and draining by incision, or the excision of a limited portion of one or more ribs, has failed to afford relief. The size and extent of the abnormal cavity should be estimated with the finger or probe, or by the means of fluid injection. An incision made along the center of an intercostal space affords opportunity for removal of two contiguous ribs; two corresponding incisions, the removal of four ribs, etc. (Estländer). The soft parts overlying the ribs of the outer wall of the cavity are raised as a single flap, or two or three small flaps are formed (Jacobson), according to the size of the cavity, condition of the patient, and the predilection of the operator. The smaller the flap the less is the hæmorrhage and shock; and, too, if the first flap be centrally located and the rib removed, further procedure at that time can be deferred, if need be, and yet the patient's condition will have been improved by the primary measure. With the large flap these considerations are scarcely applicable. After exposure of the ribs by either method, they are separated from the remaining soft tissues, by means of a slightly curved elevator, to the full extent of the cavity, and divided at the limits of exposure with a fine saw or bone-cutting forceps, and removed. The periosteum should be removed either with or following the enucleation of the rib.

*The Remarks.*—Unless in all radical methods the thickened parietal pleura of old cases and the associated tissues are removed along the line of bone section, and the empyemic cavity is thoroughly exposed, scraped, cleansed, wiped out, drained at the dependent portions, and, if need be, lightly packed with aseptic gauze, satisfactory relief need not be expected.

**Schede's** operation is applicable to all cases with greatly thickened pleura. In this method a U-shaped incision—beginning in front at the outer edge of the pectoral muscle, on a level with the axilla (fourth rib), extending below to the lowest limit of the pleura (tenth rib), and behind up along the vertebral border of the scapula to the second rib (Fig. 1257)—is made down to the bony frame of the chest. This flap is dissected from the ribs, and the

scapula and the subscapularis muscle are raised from the trunk. The ribs from the second downward are resected subperiosteally from the costal cartilages to the tubercles. The intercostal structures and the pleura are removed with large blunt scissors, and the surface is curetted, thoroughly cleansed, the flap replaced, and the borders are united together, with the expectation of securing primary union.

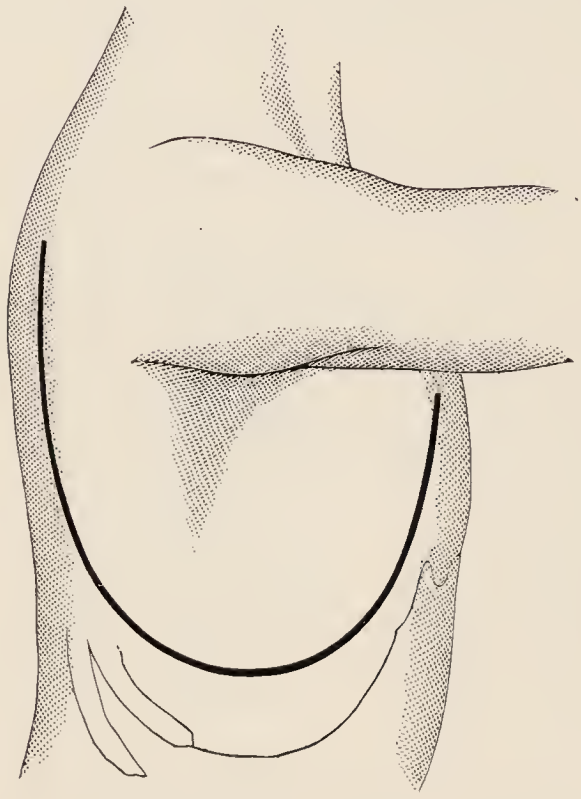


FIG. 1257.—The operation of thoracoplasty, Schede's method.

*The Comments.*—The scapula should be drawn forward out of the way as the posterior incision is made. After removal of the ribs, the remaining tissues are cut away, beginning at the fistulous opening, if one be present, and passing to divide the posterior border first, thus reducing the bleeding to a minimum. Pinching of the vessels between the thumb and fingers before division will lessen the loss of blood. The return of the flap to the opening often leaves an incomplete closure above, which, however, finally heals.

*Delorme* forms an osteoplastic flap extending from the third to the sixth rib, with the pedicle above and posteriorly (Fig. 963). In front the ribs and intercostal tissues are severed; at the upper and lower borders the intercostal tissues, behind the ribs, are divided and perhaps resected to a limited extent, and the flap is turned backward. The surfaces are thoroughly curetted, cleansed, and freshened, and apposed by returning the flap in place and uniting its borders with sutures.

If the periosteum be left behind along with the parietal pleura, etc., care should be taken to keep the tissues in apposition to the walls of the cavity, or the rapid development of the new bone may negative the attempt at cure. If one flap only be made it is usually of an oval (Schede) or rectangular form (Delorme), with the base upward to facilitate drainage. A single vertical incision (Gould) with lateral displacement and retraction of the tissues can be employed if the cavity be somewhat narrow. *Fenger* practices the removal of rib fragments of diminishing lengths, beginning at the center of the cavity in those in which the transverse diameter is the greatest at that point. If the vertical diameter be the greater, this surgeon practices the same plan of procedure, only much shorter portions are removed, for obvious reasons. The second rib is rarely resected, on account of its high position and the greater importance of its anatomical associations. The first rib is of still greater significance in these respects, and should be let alone, except in the rarest of instances. From the third to the seventh inclusive are the ribs usually resected, and from the tubercles to the cartilages, if need be. In extensive excision the shock may be great, and the deformity will be pronounced. The lung will not resume the usual position, but the parietal soft parts will obliterate the cavity, if adhesion to the lung-

be secured. A sinus of moderate extent may follow, especially if the apex of the cavity be not likewise occluded.

If the patient have tubercular disease the outlook is much impaired, and the simpler methods are advisable, at least as preliminary measures. Each case must be estimated according to its assets, as to the variety, extent, and time of operation, and as to whether an extensive procedure be made at all. All of the unyielding bony wall should be removed in every instance, if cure is to be expected.

*The After-treatment.*—Gymnastic exercise and forced expiration (breath gymnastics) constitute the main measures directed to restoration of symmetry. High elevations exercise a curative influence.

*The Results.*—The deformity is not cured, and, in fact, is increased by the operation, but may diminish later. The danger of amyloid degeneration is obviated, and substantial cure may arise. The shock is often great, and corresponding care should be exercised to avoid an unfavorable issue from this cause.

**Caries and Necrosis of the Ribs and Sternum.**—*Thoracotomy* is practiced for the relief of this condition, and commonly with eminent success. Caries and necrosis of these structures follows sometimes injury, resection, syphilis, and typhoid fevers. The ribs from the fourth to the eighth are most often diseased, and usually near the middle portions. Such complications as empyæmia, burrowing of pus, causing abscess at distant situations—i. e., of the back, abdominal wall, and even remoter parts—are noted. Rarely indeed are the pleural cavity and lung secondarily involved. The seat of the disease of the rib is usually characterized by the presence of an abscess or of a sinus. Usually operative relief is simple and effective. A horizontal, straight, or a T-shaped incision is made over the seat of the disease, the skin and muscles are conjointly reflected, the abscess is isolated, preferably without opening it, and dissected away, followed by cleansing of the parts with an antiseptic solution. A free incision is made down upon the long axis of the diseased bone (Fig. 1248) in the line of a sinus when present, the extent of the disease is determined, the bone exposed and cut off outside of the affected limits, preferably with a Gigli-Haertel saw (Fig. 1247, *n*), perhaps with a bone forceps. The diseased bone is removed, the associated morbid products dissected and scraped away, the parts thoroughly flushed with an antiseptic solution, the flaps returned to place, and the borders sutured together with catgut. In the instance of the sternum the fistulæ are slit up in the line best intended to secure good observation and drainage of the diseased area. The diseased products are cautiously removed by means of the trephine, periosteotome, bone gouges, scoops, etc. (Fig. 327), remembering that the anterior mediastinum may have been invaded. The posterior surface of the sternum may be diseased more extensively than at first seems apparent. Abscess and sinus associated with caries and necrosis of those structures should be carefully sought for, scrupulously cleansed by scraping and douching, and independently drained.

*The Remarks.*—The preservation of the upper end of the sternum is especially significant because of its mechanical association with the ends of

the clavicle. Disease of the posterior surface of the sternum is apt to be insidious, and may become quite extensive and pus point even at the intercostal spaces at the sides before the gravity of the cases is fully appreciated. The fact that the pericardium may be intimately associated with the posterior surface of the bone suggests care in the manipulations incident to the treatment of the bone and mediastinal abscess.

*The Results.*—The immediate results of operative treatment are highly favorable. Final cure is often much delayed because of the frequently specific nature of the trouble, the inaccessible locations of the disease, and the tortuous outlines of the sinuses, to say nothing of the complications of an organic character.

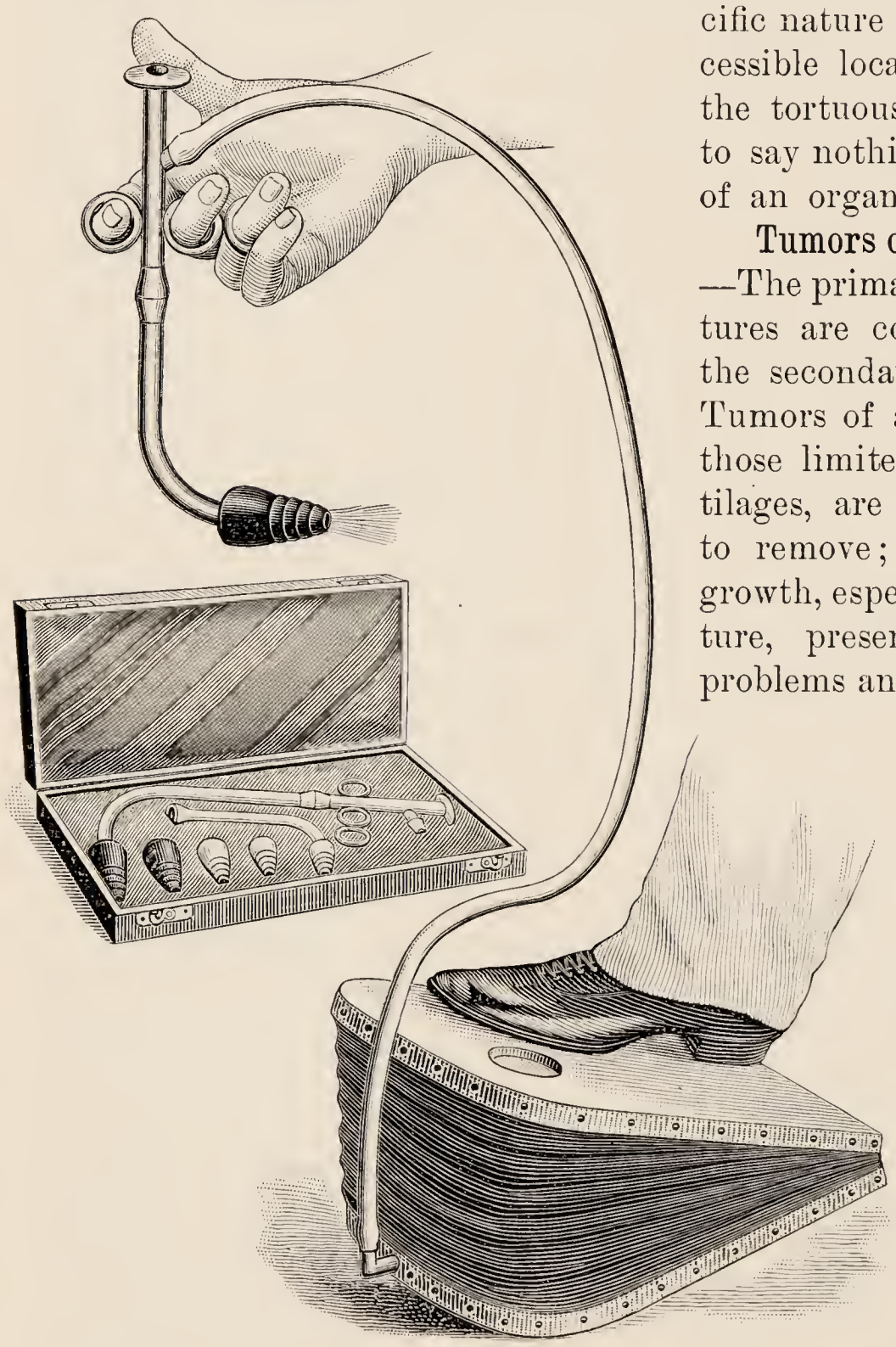


FIG. 1258.—The Fell-O'Dwyer apparatus in action, showing the bellows, assorted sizes of intubation cones, and the conductor. An intubation cone of suitable size is pressed into the larynx so as to prevent the escape of air between it and the laryngeal wall. The bifurcated arrangement of the conductor regulates the amount of air introduced by means of the thumb acting as a valve at the point of escape.

**Tumors of the Ribs and Sternum.**—The primary tumors of these structures are comparatively infrequent, the secondary are exceedingly rare. Tumors of an innocent nature, and those limited to the bones and cartilages, are not, as a rule, difficult to remove; but those of extensive growth, especially of a malignant nature, present frequently complex problems and insurmountable obstacles to removal for consideration. Thorough aseptic method and free exposure of the seat of disease are essential elements of the technique. A large, oval, musculo-cutaneous flap, with dependent convexity, located so as to facilitate observation and manipulation, should be made. The bone is severed at the outer limits of the disease by saw, forceps, or chisel and mallet (Fig. 327), and cautiously raised, along with the morbid growth from the body, by means of careful dissection. If the growth is malignant, the extent is problematical, and the possibility of complete removal is uncertain. Exten-

sive areas of disease involving the sternum, ribs, pleura, and even the pericardium, have been successfully removed and the patients have recovered. An important feature of the removal of these growths relates to whether or not the disease is extrapleural or intrapleural. In the former instances the danger of operative involvement of the pleural cavity is a matter largely under the control of the surgeon, who, by the employment of judicious forethought and cautious technique, will rarely indeed invade this cavity unless the pleura itself be involved in the disease. When, however, the removal of malignant growths is attempted, the invasion of the pleural cavity must necessarily be frequent and often extensive if practical benefit is to follow operative practice. Therefore, the special dangers of sudden and persistent pneumothorax, of hæmorrhage, of shock, of infective pleuritis, etc., force themselves at once to the front. The prevention and successful control of the grave consequent complications of these operations is a matter of pronounced importance. Shock and hæmorrhage are the dangerous features in operations in cases of non-pleural involvement. They should be anticipated and met along the lines that characterize their presence in operations on other parts of the body. In intrapleural involvement, pneumothorax, hæmorrhage, and shock are serious complications, and the first is truly formidable when suddenly occurring in the presence of either of the others. However, it ought to be recognized that not infrequently little or no special disturbance attends surgical invasion of the pleural cavity in those cases. *Parham's* investigations show that "little or no disturbance" followed in about 40 per cent, "moderate disturbance" in about 24 per cent, and "quite stormy manifestations, even threatening life," in about 36.5 per cent of the cases in which the pleural cavity was opened. The larger the hole, and the longer time it remained open, the severer were the effects. The severe manifestations occurred in pneumothorax of the right side nearly twice as often as in that of the left. Parham's investigations emphasize the practical wisdom of operating before involvement of the pleura, of establishing preliminary adhesion of the surfaces by sewing, etc., of prompt closure of the tear by the finger, by a compress, or suture. *Keen* closed the opening in the pleura by stitching the lung to the border.

The induction of extrapleural hydrothorax (page 1045) and of deep inspiration with final closure of the wound are available methods of treatment.

*Matas* and *Parham* regard the *Fell-O'Dwyer* apparatus (Figs. 1258 and 1259) for forced artificial respiration as an agent of great significance. The latter surgeon considers it an essential part of the operative armamentarium, "intended to revolutionize this field of surgery." *Northrup** extols the apparatus as "an efficient aid in carrying on prolonged artificial forcible respiration."

The following is substantially the text of a recent communication from Dr. Fell descriptive of the apparatus employed by him for the purpose of inducing forced respiration (Fig. 1259): "The apparatus which I have used and found so efficient in cases of forced artificial respiration, consists of a bellows

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* Presbyterian Hospital Medical and Surgical Report. January, 1896. Vol. I.

(*a*), the size of which has been determined by my experience. It is operated as follows: Three movements for inspiration and three for expiration. This will produce eighteen or twenty respirations per minute when worked at a convenient rate of speed. The attempt to operate it so that a single movement

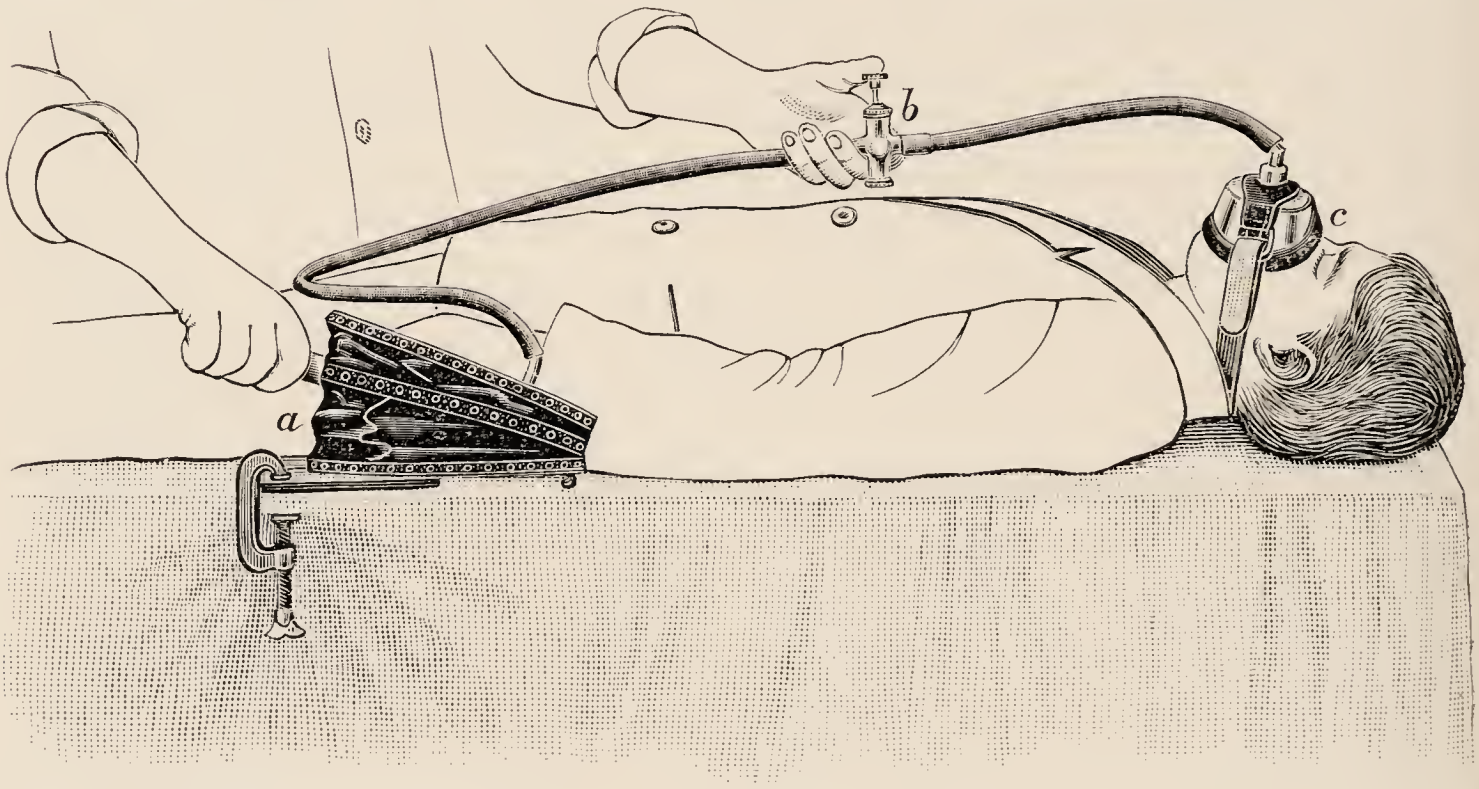



FIG. 1259.—Forced artificial respiration, Fell's improved apparatus. *a*. Bellows. *b*. Air valve. *c*. Face mask.

represents an inspiration would almost certainly defeat the purpose for which the apparatus is intended. The anæsthetic can be administered by placing a sponge or gauze, properly saturated with the anæsthetic, over or in proximity to the opening through which the air enters the bellows. A simple arrangement constructed on the principle of the chemist's wash bottle, by means of which oxygen can be made to pass through a tube into the air valve, thence with the anæsthetic into the lungs, can be attached. This device, along with that for mingling oxygen with the inspired air, makes a complete outfit for the purpose. Next to the bellows is the air valve (*b*), with which it is arranged to act. The operator presses down the piston of the valve a full stroke during three movements of the bellows, thus causing inspiration by permitting the air saturated with the anæsthetic to enter the lungs through either of the selected channels—i. e., the face mask (*c*), the intubation cone (Fig. 1258), or the tracheotomy tube (Fig. 1260). The piston is then released until three movements of the bellows are made, which permits expiration to occur. Before the operation is begun the mask should be snugly fitted to the face to prevent any uncertainty in this respect. If during inspiration it does not fit so that the cheeks may bulge somewhat without air escaping by the sides of the mask, its best action can not be attained. Frequently a pad or folded handkerchief placed over the bridge of the nose will secure a tight fit. If an intu-

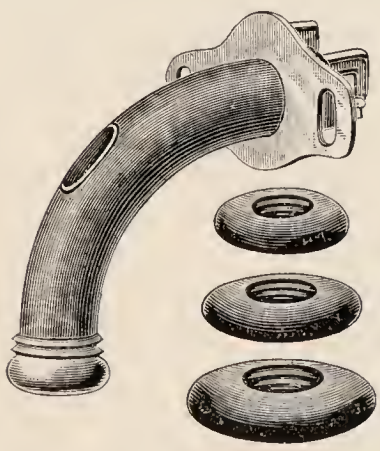


FIG. 1260.—The tracheotomy tube and rings used in forced artificial respiration, Fell's method.

bation tube be employed, a rubber tube from the air valve can be connected with the former and good inflation can then be secured, provided that the end of the tube is of proper size to fit the trachea. My best results in long-continued respiration have been secured by means of tracheotomy and the occluding of the trachea with a suitably sized ring screwed to the end of the tracheotomy tube (Fig. 1160). But for operative work on the thorax the other methods appear to be the better suited. The size of the bellows and the manner of its operation should be suited to the requirements of individual cases—i. e., one movement for inspiration and one for expiration in a child, two movements for inspiration and three for expiration in a youth, and three for inspiration and the same for expiration in an adult will usually suffice."

Aspiration only, and aspiratory drainage (page 1026 *et seq.*) in cases of effusion, should be employed.

*The Precautions.*—Be sure and cut wide of malignant disease, removing its manifestations entirely when practicable. Avoid operation in these cases when complete removal is regarded impossible, except for the purposes of euthanasia. The thin pleura lying beneath innocent growths will be torn in their removal unless great care be exercised. Hæmorrhage is often profuse in removal of innocent growths, and always so and persistent in removal of the malignant.

*The Results.*—Of 26 extrapleural operations, 7 died and 19 recovered. Of 51 intrapleural operations, 16 died and 35 recovered. Recurrence followed within a year in 7 of 10 cases of extrapleural, and in 12 of 23 cases of intrapleural operations.

**Wounds and Hernia of the Diaphragm.**—Attention to the attachments of the diaphragm to the thorax, and to the peculiarity of its structure, is important as preparatory to the consideration of wounds and hernia of the organ. Also its relation to contiguous viscera, and the influence exercised on them by its presence and movements, should not be overlooked. Wounds of the diaphragm often escape a suspicion of their presence, healing without manifest difficulty, or are revealed either on autopsy or by an explorative incision directed to the relief of complicating hæmorrhage, a visceral wound or an acute intestinal obstruction provoked by strangulation consequent to the original injury. The situation, direction, and extent of a wound of the thorax will often suggest diaphragmatic involvement, while other evidence escapes observation. Diaphragmatic herniæ are either of congenital origin or due to injury, and in either instance they may escape detection or thought, until revealed by autopsy or explorative operation. Hernia from either of these causes happens much oftener at the left than the right side. Congenital protrusions occur more frequently posteriorly than anteriorly, and, as elsewhere, their size and shape are regulated by the characteristics of the opening. In only about 10 per cent of the cases are the displaced viscera provided with a sac, and the great majority of those are of congenital origin. The stomach, colon, small intestines, liver, and even the pancreas, cæcum, and kidney appear in the protrusion, and in point of frequency in the order stated. Stab and contused wounds are most often the exciting causes of this variety of hernia, and of those arising from the former cause but one

third suffer at once from the hernial infliction; in the remainder, months and years may elapse before herniæ become manifest. At all events, in 88 per cent of the cases death follows sooner or later from the effects of the wound, prompt strangulation covering about 9, and late, about 14 per cent of the deaths. From the aforegoing it follows that wounds of the diaphragm call for prompt explorative diagnosis and repair, irrespective of hernial manifestation. The detection of a wound of the diaphragm is best accomplished by manual examination made through a high median incision in the abdomen. By this means the under surface of this muscle can be carefully and comprehensively examined on either side of the body. If a defect is found, it should be repaired as soon as the condition of the patient will permit.

*The surgical treatment* of diaphragmatic wounds and hernia may be effected either by way of the abdomen or the chest (Figs. 1030, 1031, and 1090). By the former route the entrance is easy, but the treatment is difficult because of the position of the diaphragm and the influence on the protrusion of negative pressure. The latter route, while readily available, easy of attainment, and opposed to the influence of negative pressure, exposes the pleura and lung to the consequences of thoracic invasion, which in feeble and diseased subjects is often a matter of grave importance. However, as the surgeon in these cases usually opens the abdomen with the view of relieving intestinal obstruction, and meets, perhaps, with an unsuspected strangulated diaphragmatic hernia, which has already infected in a greater or less degree the pleural cavity, and can not be returned safely, if at all, without opening the pleural cavity, it is surely seen that the thoracic route is often essential for the treatment of such cases. A wound of the diaphragm should be suspected when the seat, direction, and depth of the injury are such as to suggest the possibility, and especially when the symptoms do not conform with the history of an injury of a simpler nature. Usually these wounds are explored along the line of injury, the soft and hard parts being turned aside as the needs of observation, arrest of hæmorrhage, and of repair demand.

If the seat of entrance of the penetrating agent be located at some distance below the ribs, a median abdominal incision for diagnostic purposes may be made, followed by a thoracic, if repair from below be impracticable or a hernial protrusion of the diaphragm be present. In the pleural route the recent wound or the adult scar is employed as a guide to the seat of operation. A large flap of the soft parts, corresponding preferably to the seventh intercostal space (Fig. 1090), is made, followed by resection of two ribs of sufficient length to afford the opportunity of careful observation and of prompt adequate repair of the rupture. If a hernia be present, the condition of the protrusion should be carefully noted before reduction is attempted. If it be gangrenous, a commodious median abdominal incision should be made at once, the tissues around the point of escape thoroughly isolated with rubber dam and aseptic gauze before an attempt at reduction is made. And, too, the contents of the intestine, with which it is continuous, should be pushed aside and retained before reduction, not only to increase the opportunity of manipulation, but also lessen the danger of

extravasation. Whenever a lack of proper vital integrity of the protrusion is suspected, the final treatment and observation should be carried on through a median abdominal incision. Resection of gangrenous intestine and the formation of artificial anus can not be practiced through the chest walls. When thoracic observation establishes the belief in the integrity of the protrusion, it should be thoroughly cleansed, returned to the abdomen, and the opening in the diaphragm repaired by sewing. The wound of the thorax is closed, and the patient treated otherwise as for hernia elsewhere.

*The Precautions.*—A careful scrutiny of the protruded part is necessary before an attempt at reduction is made, especially if there is reason to believe that the vitality of the hernial protrusion is impaired. Vigorous traction in reduction should not be practiced in any instance, as relief can be had if only a small incision into the thorax is made. If air have already entered the thorax, or the opening be a free one, or the passage through it by the side of the neck of the hernia of a small hollow instrument for admission of air be practicable, the making of the thoracic opening may be avoided. It should be kept in mind that the addition to the already depressed state of the patient of a pneumothorax may cause of itself a fatal issue; therefore, air ought not to be permitted to enter the pleural cavity except when a discreet use of other methods of reduction has failed. The introduction of the finger through the opening by the side of the hernia is apt to injure the gut at that situation, and should not, therefore, be harshly done. Instead, a small grooved instrument should be introduced at the side, and the opening increased by cutting, remembering always that septic matter may at once escape through the opening into the abdomen. Contused wounds of the abdomen and chest may cause rupture of the diaphragm with all of its manifestations. The possibility of injury of the pericardium and lung should not be overlooked.

*The Remarks.*—The technique of repair, of cleansing, and of drainage in these cases is similar in all important respects to that of surgery of the serous cavities generally. Fatal issues quite too often afford the opportunity for a diagnosis that at least should have been suspected before. In the instances of aseptic wounds the ribs may be sutured in place by union of the denuded ends with fine silver wire. The results were considered already in the beginning of the discussion.

**Hæmothorax.**—The presence in the pleural cavity of a greater or less amount of blood, dependent on a wound of a vessel of the thoracic wall of the lung, or of an intrathoracic viscus or vessel, is denominated hæmothorax. The seat and age of the wound, together with the amount of the bleeding, will indicate quite pointedly the vessel or viscus involved. In the great majority of instances the bleeding will have ceased already when the patient is first visited by the physician, and the primary aim should then be to maintain quiet to prevent recurrence of the hæmorrhage. Later, the question of absorption of the blood will need consideration. Fortunately, the strong tendency to rapid and complete absorption of even large amounts of blood from the pleural cavity without manifest local disturbance

favors the exercise of discreet waiting for the evidences of degenerative changes before active steps are taken. When local and constitutional symptoms indicating the presence of pus appear, the case falls under the category of empyema, and is best treated by the operative measures addressed to that affliction. If hæmorrhage recur, or be progressing at the time of the first visit, prompt measures for arrest must be employed at once to prevent further loss. If the loss of blood arise from the wound of a vessel of the thorax, plugging of the wound, followed promptly by ligature of the bleeding ends under local anæsthesia, should be employed. When, however, the escape has a deeper and more obscure origin, is persistent and dangerous to the life of the patient because of the increasing loss of blood, or from its direct interference with the respiratory capacity, operative practice may then be regarded as the only measure that will afford relief. Operation under these circumstances is a serious matter indeed, and should always include preparation for the prompt and effective use of saline transfusion.

*Aspiration of the thorax* may effect the removal of a sufficient amount of the blood to afford relief from the respiratory oppression without provoking fresh hæmorrhage. If this simple measure fails to afford the requisite aid, explorative entrance of the chest by raising an osteo-cutaneous flap of suitable size, and so located as to provide the opportunity for free inspection and proper repair of the injury, should be practiced (Fig. 963). After removal of the blood, the seat of escape should be sought for at once, and the hæmorrhage arrested by catching or clamping the bleeding points or surfaces, followed by suitable repair of the damaged structure. The bleeding points of injured vessels are closed by ligature. Injured viscera are treated according to the nature of the wound and the length of time safely at the command of the surgeon. Small, shallow wounds of the lung, and those demanding instant relief, may be satisfactorily treated by the introduction of iodoform-gauze plugs, one end remaining outside of the chest. But in all instances in which plugging is employed the gauze should be carried to the bottom of the wound, even though the entrance requires enlargement for the purpose; otherwise hæmorrhage will not be fully arrested. Tying of the bleeding surface or opening with a ligature has been practiced successfully, but in the latter instance is exposed to the risk of not controlling entirely the divided structures, especially of the deeper parts of a wound. The use of continued or interrupted sutures of any form are open to the objections that they invade the air cells, puncture the vascular structures, and may fail to command entirely the divided surfaces of deep wounds. In superficial wounds sutures have been satisfactorily employed. After repair, the parts are thoroughly cleansed, drainage provided, flaps restored to place, and so united as not to interfere with drainage, the wound is dressed aseptically, patient placed on the injured side, and quieted with small doses of an anodyne.

*The Precautions.*—Miscellaneous probing of a wound of the chest should not be practiced. The cautious use of a silver probe or of a finger clothed with a tight-fitting aseptic rubber cot (Fig. 160) may be of service in determining the direction of the injury and the probability of entrance to the chest,

in the absence of other signs. Chest wounds should be promptly and aseptically closed at once, unless especially contraindicated. After entrance to the chest, the blood should be removed as rapidly as possible in order to discover and arrest bleeding at once. A strong movable light will facilitate the search for the seat of injury and contribute much to hasten repair. Careful scrutiny is sometimes required to detect the seat of a slight injury of the lung, especially when received at the borders of that viscus. Transfusion may be required during the course of the operation, possibly before and quite certainly afterward.

*The Remarks.*—Thorough asepsis should be practiced in all respects. The unusual tendency to fluidity of blood in the pleural cavity renders aspiration for the purpose of removal entirely feasible and often unexpectedly successful. A U-shaped flap of the soft parts is commonly made and turned aside; limited portions of two or three ribs are then excised, often subperiosteally, and removed, followed by a smaller flap of the pleura and intercostal structures. Injuries of the heart are treated under a separate heading (page 1057). Immobilization of the chest, so far as may be consistent with the demands of breathing, and the use of opium, to restrain coughing, are to be commended. In those instances in which much disorganization of the lung is present, and in which pressure is requisite to control the bleeding, sufficient gauze may be introduced into the thorax to effect the purpose.

*The Results.*—In 86 cases of hæmothorax from penetrating wounds of the chest, 22 recovered and 44 died without operation. Of the 22 treated by puncture or incision to relieve pressure on the lung, 4 died (Nélaton).

**Abscess of the Lung.**—The history of voluntary surgical attack on the lung is a long one, replete with indications of persistent effort, interrupted by frequent discouragement, and finally crowned with practical success. Abscesses vary in size, form, number, and situation—facts that should be recognized as influencing the outcome of operative practice. Usually the diagnosis of abscess is established by aspiration before the need of operation is announced. Sometimes the latter follows immediately the determination of the need by the former, and is consequently a part of the procedure.

*The Operation.*—Under thorough aseptic preparation and local anæsthesia, introduce at the center of the field indicating the seat of the abscess, as determined by the physical signs, a short, strong, aspirating needle (Fig. 1091) (with a lumen of about half to three quarters of a line in diameter) already connected with an aspirator; open the stopcock controlling the aspiration as soon as the end of the needle is well buried in the tissues; slowly and cautiously press the end of the needle into the chest, carefully watching at the same time for the appearance of pus in the glass segment of the tube. When pus appears, leave the needle in place as a guide to the abscess if relief is to be sought at once. Otherwise, slowly withdraw the needle, noting carefully the site, deviation, and depth of penetration for after guidance. Close the seat of puncture with collodion, and while noting the effect of the exploration prepare for operative relief. In operating raise a U-shaped musculocutaneous flap of ample dimensions; with the convex portion posteriorly, and with the needle as a guide to the pus, divide antero-posteriorly carefully along

the course of the needle with a scalpel the various tissues down to the parietal pleura, excising limited portions of one or more ribs if need be. *If the pleural surfaces are adherent* to each other, continue the dissection along the needle into the abscess, which is then carefully evacuated and drained. *If adhesions are not present*, and the case is urgent, unite the pleural surfaces with each other by sewing with chromicized catgut supplemented with gauze packing, and continue the dissection. If the case is not urgent, pack the wound with gauze, and at the end of two or three days finish the operation under the protection of the newly formed adhesions.

*The Precautions.*—The precautions incident to penetration of the chest in empyema, etc. (page 1023 *et seq.*), are of equal force in this condition. If pleural adhesion have not taken place, collapse of the lung will follow invasion of the pleural cavity, and seriously hinder, if not defeat entirely, the safe evacuation of the pus. Therefore, one should not, unless unavoidable, divide the pleura until after adhesions are established. With a non-adherent pleura the movements of the lung can be seen and felt through the exposed parietal layer of the membrane, and a needle thrust through it into the lung will oscillate with the respiratory movements, and not move only upward and downward with the chest wall as in the instance of pleural adhesions. It is often comparatively difficult to divide or pierce a thickened adherent pleura; moreover, the history of the physical signs of disease of the pleura will indicate adhesion. Should pus escape into the pleural cavity during evacuation of the abscess, free dependent drainage of the cavity should be established at once, and the cavity thoroughly flushed with a saline solution. The fibrous bands often noted by the finger in exploring abscesses should be cautiously treated, as they not infrequently support and conceal important blood-vessels. The introduction of the fingers into the cavities and flushing is not advisable. In the instances of non-adhesion, gauze pressure only is too uncertain to be regarded as an acceptable substitute for sewing with catgut. In deep introduction of the exploring needle, the advancing end should be directed away as much as possible from important structures. Inasmuch as the abscess may be missed entirely on exploration, or the pus be too thick to flow, or have been nearly discharged by coughing, a microscopical examination of the contents of the lumen of the needle should be made to determine the nature of its contents before this means of detection is discontinued. Needles of increased caliber may be employed if pus be found in the lumen of the smaller, keeping in mind the fact that it is not always possible to locate an abscess by this method of practice. Abscess and empyrmic cavities communicating with a bronchus should not be flushed, as the fluid may enter the bronchi and suffocate the patient. *Janeway* warns against the danger of giving anæsthetics in such cases, and emphasizes the admonition by repeated instances within his own knowledge in which patients have been suffocated by pus while insensible to its presence in the lung, because of anæsthesia.

*The Remarks.*—The means for making a passage through the lung tissue into the abscess cavity are quite numerous and variously indorsed by operators. Trocar and cannula, the knife, the cautery, and blunt dissection are commonly employed. *Paget* regards with especial favor the use of a fine

director fitted closely around the needle of an exploring syringe. They are caused to pierce the lung combinedly, and after determining the presence of pus by aspiration, the needle is withdrawn, leaving the director in place to serve as a guide to the abscess. Along the director dilating agents of increasing size are successively carried, thus opening a commodious channel into the abscess. Cautious dilatation is essential, otherwise serious bleeding may be provoked, requiring that the wound be plugged to arrest the hæmorrhage. Cautery is a safe and efficient agent when employed with discretion. The advance through the tissue with this agent should be slowly made and the instrument removed cautiously, and only after the tissues are seared sufficiently to permit the withdrawal without tearing away the cauterized tissue and causing severe hæmorrhage. In superficial abscess blunt dissection may be safely employed. Hard pulmonary tissue may be safely cut, the soft as safely treated with cautery. The cautery and gauze tampons should always be at hand to arrest hæmorrhage. Cavities at the apex of the lung drain readily into a bronchus; those at the base do not, and for apparent reasons.

The distance of the proposed entrance of the needle should be indicated upon it before beginning the act, to avoid needlessly dangerous encroachment on the contents of the thorax. The sewing together of the pleural membranes in the absence of adhesion lessens the danger of collapse of the lung, and correspondingly facilitates the ease and rapidity of subsequent operative efforts. *Tuffier* commends transpleural examination of the lung for localization of abscess. The parietal pleura is separated from the chest wall for a sufficient extent to meet the required purpose, and through it the physical state of the lung is estimated by the hand, and thus the abscess is located. However, this additional severity to the operation added to the increased opportunity of infection, does not favorably commend this modification. If an abscess communicate with a bronchus, a tampon of gauze should be employed to close the opening into the bronchus, and thus aid the function of respiration, otherwise a drainage tube may be employed. *Beck* introduces a narrow strip of gauze into the abscess cavity, cleanses the pleural cavity, packs it with gauze, and administers morphin to control the cough. He causes expulsion of the pus from the cavity by causing the patient to blow out from time to time with the mouth and nose closed.

*The Results.—Paget* reports 14 complete recoveries in 42 operations for simple abscess; 3 recovered with fistula, 24 died, and in 1 the result is unknown. *Fabricant* reports 38 cases of operation for abscess, with 29 cures. *Taüfert* reports 5 operations for abscess—all successful. *Réclus* reports 17 operations for abscess following fibrinous pneumonia, with 14 cures and 3 deaths.

**Bronchiectasis.**—Operations on dilated bronchi are very unsatisfactory. (The majority of patients do not improve at all, and the few that do as a rule rapidly become worse.) While a single well-formed cavity may be amenable to operation, the fact that there are usually multiple dilatations, and at the best but temporary benefit need be expected, offers a meager benefit for the danger incurred. The means of detection of the cavity and

the general technique of the operative procedure are substantially similar to those employed for abscess of the lung.

*The Results.—In bronchiectasis*, *Tuffier* reports 45 operations with but 7 improvements; *Paget* reports 12 operations, with 8 deaths and no complete recoveries.

**Gangrene of the Lung.**—Gangrene of the lung is a secondary disease, and therefore largely influenced in extent, location, and circumscribed state by the nature of the disease or injury which it complicates. Therefore, it is important in considering the advisability of surgical effort to note whether or not the associated cause leads to the circumscribed or diffuse variety of gangrene, and whether it is likely to be superficial or deep. Uncircumscribed or diffuse gangrene of the lung is much less suited for operation than that located in less delicate and important functional parts of the body. And in the lung or elsewhere in the body, circumscribed superficial gangrene is the most favorable for operative treatment. Operation should be performed early enough, if possible, to anticipate the occurrence of sepsis, perforation of the pleura, and consequent pyæmia and hæmorrhage.

*The Operation.*—The advantages of physical diagnosis and of explorative puncture are utilized to locate the seat of the disease. Turn aside a U-shaped musculo-cutaneous flap corresponding to the site of the suspected gangrene; cautiously resect a portion of one or more ribs carefully, avoiding injury of the pleura. *If adhesions are not present*, separate the parietal pleura from the chest wall and practice transpleural palpation of the lung, in order to locate accurately by touch the seat of the disease. Having located the seat of the disease, resect the ribs sufficiently to permit of easy approach to and treatment of the gangrene; sew together around the superficial area of disease by means of a continuous chromicized catgut suture, introduced in the manner of the domestic "back-stitch" (Roux), the non-adherent pleural surfaces; pack the outer limits of the wound with gauze, and introduce at the center of the area an aspiration needle; cut through the parietal pleura freely, thus exposing the seat of the disease; open into the gangrenous area with a trocar and cannula, or with a cautery; cut away with knife or scissors the superficial gangrenous portions, wiping the parts with gauze pads. If fluid be present in the pleural cavity it should be removed, the cavity thoroughly cleansed, drained, and packed with gauze before the gangrene is treated. If ample adhesions be present between the serous surfaces there is no need for delay in the operation.

*The Precautions.*—It is wise to pack the wound after sewing together the pleural surfaces, and wait four or five days before attacking the gangrenous area, if the patient's condition will warrant the delay. An infected pleural cavity should be kept thoroughly cleansed, and dependent drainage should be maintained and gauze packing employed during the treatment of a gangrenous lung. Gangrene extends downward toward the base of the lung; therefore the opening into the chest should be extended in a downward direction for the purposes of treatment. The pleura is attached less firmly to the intercostal structures than to the borders of the ribs; consequently the separation should be commenced at the former situation. In separating

the pleura from the chest wall care should be exercised to prevent tearing; the separation should be done slowly with the fingers toward the pleura (Tuffier). In sewing the pleural surfaces together the visceral layer should be picked up during inspiration, and in order to secure a reliable line of apposition the continuous suture, preferably the "back-stitch" variety, should be introduced. When gangrene is deeply situated in the lung, the cautery at a dull-red heat is the safer agent to employ in the treatment.

*The Remarks.*—Prompt operation, if practicable, should follow the withdrawal of pus from a lung cavity, by aspiration in the absence of adhesions at the seat of puncture, to avoid infection of the pleural cavity. Not infrequently cases treated by simple puncture of the cavity through the chest wall with trocar and cannula, followed by drainage, the tube being introduced through the latter agent, have satisfactorily recovered. Pleural adhesion should have preceded the employment of the measure. Counter drainage of a cavity in the lung may be deemed advisable. Incisions for gangrene, as incisions for abscess that fail to locate the disease, are not necessarily fruitless, since not infrequently in a few days a free discharge takes place through the incision and cure quite promptly follows. Gangrenous and abscess cavities should be wiped out and not flushed, especially when the cavity communicates with a bronchus or exposes the pleural cavity to the danger of infection. The X rays aid in determining the location of abscess and gangrene of the lung.

*The Results.—In gangrene of the lung* without operation, 75 per cent of the cases die (Réclus). *Sonnenberg* reports 47 operations with 35 recoveries. *Fabricant* reports 26 operations, with 16 cures and 10 deaths. *Taüfert* reports 10 operations, with 7 cures and 3 deaths. *Réclus* reports 13 cases, with 11 cures and 2 deaths.

**Tumor of the Lung.**—According to Tuffier, a patient with primary malignant tumor of the lung has never been subjected to operation. However, secondary sarcomata have been successfully removed. We can not favor this practice, because nothing tangible can be offered to those suffering from secondary manifestations commensurate with the dangers and discomfort attendant on operations for their removal at this situation. In the instance of hydatid growths the conditions are different. The lungs and pleura suffer next in frequency to the liver from hydatid disease.

*The Operation.*—Puncture and incision are the surgical methods of practice that will be considered, and the former is mentioned for the purpose of condemnation rather than encouragement. Puncture even with a small needle for diagnostic purposes should be promptly followed by incision, to anticipate fatal pleural inflammation from leakage, and often lung complications of even a prompter and more fatal outcome.

*The technique of operation by incision* is not dissimilar in principle to that employed in like treatment of hydatid growths connected with serous membranes elsewhere in the body. The tumor is located by the physical signs, and perhaps identified by means of a small hypodermic needle. A flap is raised and turned aside and a portion of one or more of the ribs resected, followed by exposure of a limited area of the parietal pleural. If the pleural surfaces

are adherent to each other, the operation is continued; if not, the wound is stuffed with gauze for four or five days, in order to establish adhesions. When adhesions are formed over a sufficient area to afford proper protection to the pleural cavity from hydatid infection, the tumor is opened along the course of an exploring needle by means of cautery or incision. The contents of the cavity are evacuated without the aid of irrigation or curetting. A short, soft, rubber drainage tube of large calibre is introduced into the cavity and the wound dressed with an abundance of gauze.

*The Precautions.*—Care should be exercised to cause a wide enough area of adhesion to prevent the entrance into the pleural cavity of infecting agents. The union of the pleural surfaces by sewing should not be relied upon to the exclusion of packing, from fear of leakage; full reliance can be placed on the packing for adhesion purposes. Preparation for prompt examination of the fluid withdrawn by the needle and for operative action should have been made before the needle is inserted, in order that incision may at once follow the diagnosis of hydatid disease. Irrigation and curetting of the cavity should not be practiced, because of the great danger of invasion of the bronchial tubes. The major part of the contents of the cyst may be cautiously removed by the finger or a small spoon, the remainder escaping with the subsequent discharges.

*The Remarks.*—The cough that often attends is lessened by anodynes. Symptomatic and other complications are treated as they arise.

*The Results.*—*Paget* regards the death rate as being from 50 to 60 per cent without surgical treatment, and states that the suffering of those who recover is severe and prolonged. The death rate from puncture is variously estimated, being from 69 (Maydl) to 27 (Thomas) per cent. The death rate from incision is estimated to be from 16 (Thomas) to 20 (Lopez) per cent.

**Tuberculosis of the Lungs.**—Active surgical interference in pulmonary tuberculosis has been quite extensively practiced and widely discussed at various times; and although striking instances of relief are not infrequently reported, the proposition itself has not met with extended professional approval. The reasons for this fact are so apparent as not to require consideration at this time.

**Tubercular Cavities.**—In not a few instances has the incision of tubercular cavities been followed by temporary relief, but rarely indeed by final cure. The fact that only palliation was expected seems to justify further effort in this regard, unless it shall appear that success is attained at a too great sacrifice. The localization of the incision in the treatment of these cavities is indicated by the physical signs. The exposure of the parietal pleura is accomplished in the same way and is guided by the same reasons as for abscess, etc. In these cases the pleural surfaces are, in a great majority of the cases, already adherent, consequently the operator proceeds at once to invade the cavity by means of a trocar and cannula or with cautery. The first two agents are employed more frequently in this than in the previously considered conditions. However, if hæmorrhage is feared because of the great depth of the cavity beneath the surface of the lung, or for any other reason, cautery is still the preferable agent for use. After the opening is estab-

lished and the contents are evacuated, cleansing of the cavity by wiping or spraying with soothing aseptic medicated fluids is indicated. The removal of the deleterious matter from the cavity is commonly promptly followed by a subsidence of the constitutional symptoms and an abatement of the local suffering and annoyance. As the result of these changes, the general condition of the patient improves for a longer or shorter period, when finally the advance of the disease in other parts of the lungs, or the increase in the gravity of the complications already established, weaken the patient and finally cause death. If the patient is so fortunate as to be inflicted with but a single cavity or the tendency of the disease be toward recovery, he secures a prolonged respite and perhaps a final cure, or possibly it may be said that he recovers sooner and with less suffering because of the operation.

*The Precautions.*—Great care should be taken to prevent the entrance of air into the pleural cavity, for the reason that the addition of the effects of a pneumothorax to that of the already crippled state of the lungs might seriously complicate matters, if not become the cause of speedier death. Careless manipulation of the walls of a cavity may cause troublesome hæmorrhage, and irrigation distressing cough and suffocating sensations. A circumscribed pneumothorax may be mistaken for a tuberculous cavity. The opening in the chest wall should be so extended as to secure good drainage.

*The Remarks.*—The X rays may aid in the diagnosis of the location of a tuberculous cavity. The employment of antiseptic solutions in the treatment of these cavities has not proved satisfactory. The use of a solution of tuberculin for this purpose has been extolled, but with questionable judgment. Sometimes contiguous tuberculous collections empty into the primary cavity. A failure to find an accumulation of tuberculous products may be followed soon by their escape through the pulmonary incision.

*The Results.*—Little can be said of favorable results. It is estimated that of 100 cases operated on 5 die from the operation, 70 live only two weeks afterward, and 15 less than four. *Paget* reports 8 cases with 6 betterments and 2 deaths.

**Resection of a Tuberculous Deposit in the Lung.**—The removal of a part or the whole of the apex of the lung for the purpose of cure of tuberculosis is not a practical proposition, as the limits of the disease can not yet be established. The area of operative approach is small, being bounded above by the clavicle, below by the second rib, and laterally by the sternum and pectoralis minor (Fowler). The opening is made in front through a U or H-shaped incision. The importance of the clavicle and the first rib require that their sacrifice be not made in the furtherance of a so unrequiting and meager return. The second and third ribs are therefore resected if need be.

*Tuffier* exposed the parietal pleura through the second intercostal space, and without resection of a rib established an extrapleural pneumothorax by separating the pleura from the chest wall, gaining at the same time the opportunity of locating the pulmonary induration by means of transpleural palpation. He opened the pleura, grasped with forceps the indurated portion, dragged it through the intercostal space, removed the tubercular mass,

returned the lung to the chest, dressed the wound without drainage, and the patient made a prompt recovery.

*The Comments.*—The production of an extrapleural pneumothorax presses together the pleural surfaces, preventing the entrance of air into the pleural cavity. The suturing together of the respective layers more rarely accomplishes the purpose. The portion of tissue removed is transfixed at the bone and securely ligatured, the diseased portion is cut away, the lung returned to the chest, and the wound treated without drainage.

*The Results.—Paget* reports 5 operations with 1 complete recovery and 4 deaths. *Réclus* asserts that "resection of a tuberculous focus ought to be proscribed."

**Temporary pneumothorax** for the cure of pulmonary tuberculosis, suggested by an Italian surgeon some years ago, has been lately presented to the profession in an interesting and able manner by Murphy,* of Chicago. The pneumothorax is caused by injecting nitrogen gas into the pleural cavity of the diseased lung, thus imitating Nature's efforts at cure by placing the lung in correspondingly similar conditions. The gas is introduced by means of a needle governed by a stopcock, without especial pain or unfavorable symptoms. The gas will remain for months unabsorbed in the thorax and the introduction can be repeated when required. *Murphy* regards the introduction of the gas into a vein as the chief risk attending the use, and reports strikingly suggestive results following the plan of treatment under his own observation. The writer commends the study of Dr. Murphy's able paper on the subject while suspending judgment and awaiting more conclusive proofs of the virtues of the practice.

**Mediastinal Thoracotomy.**—The thorax can be opened in front or behind for the purpose of removal of obstruction in the œsophagus or bronchi, and for the relief of morbid processes in the mediastina. The intricate anatomical relations and the difficulty of proper treatment afterward render the adoption of the anterior route for the removal of bronchial and œsophageal obstructions well-nigh impracticable. *Posterior thoracotomy* is well suited for the requirements of drainage, and presents less complicated anatomical problems for solution. A knowledge of the anatomical features of the operation can be gained from text-books on anatomy. *Nasiloff* in 1888, followed by *Potarca* and by *Quénu* and *Hartmann*, directed attention to opening the chest posteriorly, mainly for the purpose of reaching the œsophagus and bronchi in cases of persistent obstruction. *Rushmore*, in his somewhat recent striking case of bronchial obstruction, determined to open the chest in front, but was obliged to desist early in the course of the attempt because of the alarming state of the patient. Rushmore has since given preference to the posterior method of practice in these cases.

The writer in 1895 presented to the American Surgical Association a paper on this subject, from which the following extracts bearing on the technique of the operation are substantially taken.

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* Journal of the American Medical Association, July 23d, 30th, and August 6th. 1898.

*The Position of the Patient.*—The patient should be placed obliquely on the abdomen, with the shoulders so supported as to cause the least possible interference with respiratory movements of the thorax. The side to be attacked should be uppermost, and the body securely fixed in this position, in order that no disturbance of it shall interfere with the line of vision, nor lead to a misdirection of the manipulative methods employed for the purpose of relief. The scapula should be drawn forward out of the way. Each assistant should be at his post, and have received careful instructions regarding his duty.

*The Ascertainment of the Proper Seat of the Obstruction.*—This step is a very important one, and should be determined with great care and deliberation since the proper location is essential to a good view of the deep parts of the wound, and to the precise and delicate steps of the most important part of the technique. The center of the field of operation should, if practicable, correspond to the seat of obstruction or disease, for obvious reasons. If the obstruction be in the œsophagus, and of sufficient density when percussed by a metallic instrument to produce sound, a stethoscope applied to the back, especially to the right side, will define the situation by fixing the point of greatest density. Also the comparative relation of the obstruction to an individual vertebra may be estimated by ascertaining by means of a graduated bougie its distance from the upper incisor teeth. This comparative relation, and possibly the nature of the obstruction, can be established by means of radiography. Having determined numerically the body of the vertebra contiguous to the obstruction, the tip of the spinous process of this vertebra and the one above should be carefully located. It will be noticed that as a rule the tip of the spinous process of a vertebra is opposite to the rib of the next vertebra below, and therefore the tip of a spinous process will indicate quite correctly the rib nearest the center of the field of operation.

*The Shape and Size of the Flap.*—A flap about three inches square, including the tissues down to the ribs, when reflected inward, affords ample space for work and observation. It should correspond to three ribs, the middle one of which should be the center of the operation field. The parallel incisions should be made carefully, otherwise the knife may pass between the ribs and enter the pleural cavity.

*The Treatment of the Ribs.*—Portions of not less than three ribs should be displaced from the angles to the outer extremities of the transverse processes, in order to gain proper room for observation (Fig. 1261). The middle one of the three should be cautiously divested of the soft parts on the external surface and the borders by means of a sharp periosteotome, carefully avoiding the parietal pleura. The pleura is then separated from the inner surface of the rib by means of a strong antiseptic silk ligature carried beneath it by an aneurism needle and moved to and fro until the rib is free the entire width of the wound. A Gigli-Haertel saw is then drawn into position by the ligature, and the rib is divided at the limits of exposure and removed.

The pleura is then cautiously separated from the inner surfaces of the

intercostal tissues and the ribs immediately above and below the opening. The fingers should be used for this purpose, and the separation made only during expiration. Attention is next directed to increasing the size of the

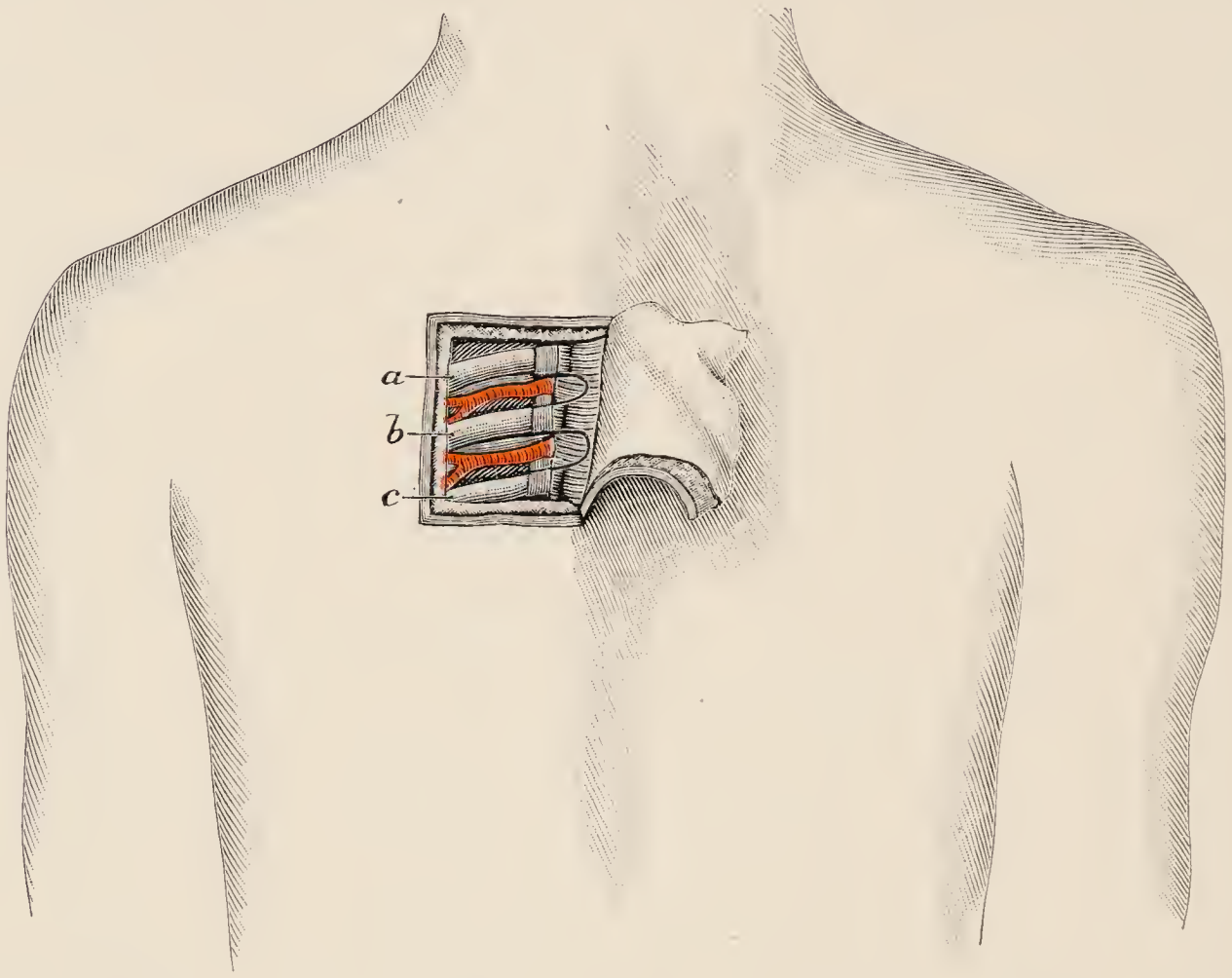



Fig. 1261.—The operation of posterior thoracotomy, the author's method. *a*, *b*, *c* indicate the three ribs involved in this illustration.

thoracic wound by the displacement of a similar portion of the adjacent ribs. The intercostal vessels between these ribs are tied at the outer and inner limits of the wound. The ribs are then divided in the same manner as the first, carefully maintaining the nutritive integrity of the intercostal tissues at the outer borders of the fragments. The fragments are then turned outward, while hinged as it were to the contiguous ribs by the intervening intercostal structures, in which intercostal vessels pass undisturbed. (Fig. 1262). This method of treatment of the ribs secures for the fragments the best possible nutritive advantages when returned and fastened in position, and also it reduces to a minimum the danger of laceration of the pleura by the bony extremities.

*The Prevention of Hæmorrhage.*—Prompt ligature of all bleeding points, and careful manipulation in the approach to the obstruction, offer the measures best intended to prevent the occurrence of hæmorrhage.

*The Location of the Obstruction.*—The site of the obstruction in the œsophagus is easily made out by the combined aid of the finger in the wound and a bulbous bougie in that passage. If the pleura be gently pushed outward with the fingers, the movements of the bougie in the œsophagus can be easily seen at the right side in the greater part of the cavity. A strong electric light is a very important aid at this time. If the obstruction be in a bronchus, this tube can be easily located by the finger before it is exposed

to view. The characteristic incomplete rings of the bronchus are readily felt as they lie directly forward and about an inch and a half from the opening into the chest.

*The Avoidance of Important Structures.*—This desideratum relates not only to approaching the situation of the obstruction, but also to the passage containing it. The vena azygos, the aorta, the pulmonary vessels, and the pneumogastric nerves must be cautiously treated.

*The Removal of the Obstruction.*—If the obstruction be in the œsophagus or a bronchus, the incision for removal should be made in the long axis of the tube, and of sufficient length to permit the withdrawal without laceration of the structures. Long-handled instruments with short blades and biting surfaces are essential, not only on account of the depth of the wound, but for the purpose of economizing space and permitting the entrance of light.

*The Treatment of the Incised Tube.*—The tube should not be closed since the presence of mucous and inflammatory products that rapidly supervene as the result of the obstruction, to say nothing of the similar products arising from the manipulative procedure itself, will prevent union. An iodoform tamponade supplemented with a centrally located drainage tube will meet the indications.

*The Replacement of the Fragments.*—The central rib fragment is not replaced, but the upper and lower fragments are, being fastened in position

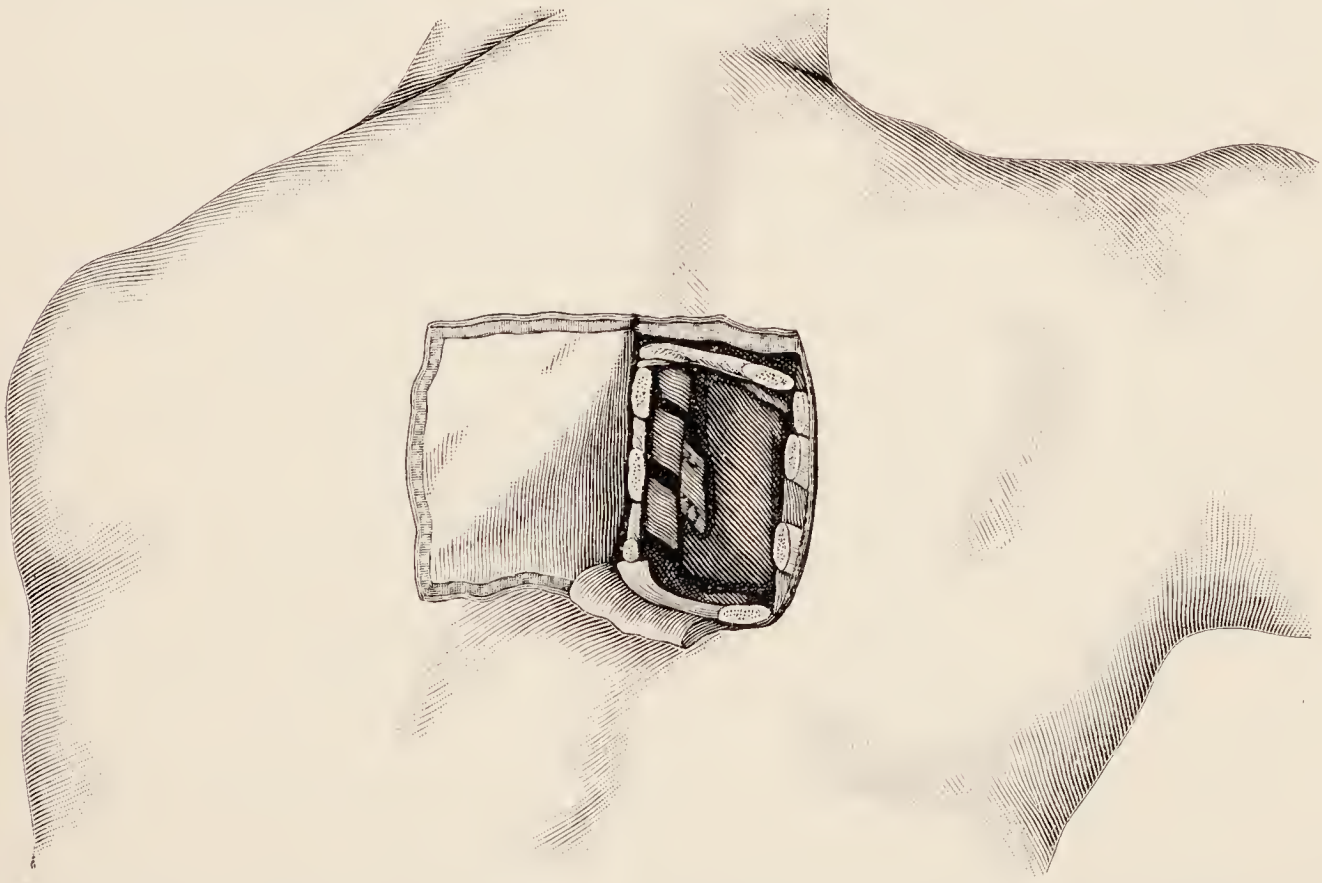


Fig. 1262.—The operation of posterior thoracotomy, author's method. Middle rib removed, the upper and lower ones turned aside, exposing the pleura and bronchus.

by means of silkworm gut or fine silver wire. If a proper aseptic state of the parts can be maintained, the bone fragments will be nourished sufficiently by the vascular hingelike attachments to the adjacent ribs to secure union.

*The Adjustment of the Flap and Dressing of the External Wound.*—The former step must be carefully considered, as the flap can not be accurately

adjusted at the outset on account of the presence of the drainage agents described. The major dressings in ordinary use for aseptic results will suffice in this instance.

*The Precautions.*—The utilization of a good light, the control of bleeding, the avoidance of laceration of the pleura and prompt closure of the opening, the cautious approach to the point of obstruction, the careful observation of the patient's condition and prompt treatment of bad symptoms, and the arrest of the operation when demanded, should characterize the procedure.

*The Remarks.*—The operation bespeaks urgent requirement and grave consideration, coupled with consummate care and forethought. It should not be attempted until other means of relief are tried and have failed; nor should delay in the attempt have sacrificed already the strength and courage of the patient. Aseptic methods, great caution, and the ability to scrutinize the steps of the procedure are the technical guides to safety and success. The advantages of the posterior over the anterior incision for the purpose of exposing the bronchi, the œsophagus, and mediastinal growths are too obvious almost to require mention. For the complex anatomical relations of the anterior way are substituted the much simpler ones posterior. The great desideratum of all wounds, and especially those of septic associations, is good dependent drainage. And if for no other reason than this the posterior way possesses an advantage which the anterior can not offset whatever else may be said in its favor. If the pleura be torn, the opening should be closed at once by tying or stitching with fine silk.

The seat of pressure on the œsophagus from without can be located in the same manner as that employed when the lumen is obstructed from within. While non-malignant involvement of the posterior mediastinum is amenable to surgical treatment, the expectation of adding comfort or longevity in malignant infliction at this situation, by surgical means, is doubtful. In cases of an assured location of a foreign body deeply situated in a bronchus, *Turc* suggests that the approach to the obstruction be made through the lung tissue by means of actual cautery.

*Curtis*, in 1896, performed posterior thoracotomy for the relief of obstruction of a bronchus of four or five days' standing in a boy about eleven years old. Because of the pioneer nature of the operation on the living patient, and the established reputation of the surgeon, the full details of the operation are quoted:

"*The Operation.*—Chloroform anæsthesia. The patient was turned over upon his face, one shoulder resting upon a sandbag, so as to render respiration easier. A quadrangular flap was raised from the posterior surface of the chest, with its base outward at the scapula and its free edge near the vertebral spines of the fourth, fifth, and sixth dorsal vertebræ. (The tips of the dorsal spines are on the same level as the angles of the ribs attached to the corresponding vertebræ.) This flap comprised the skin and fascia, and the aponeurosis of the trapezius, and was reflected outward. Some fibers of the rhomboid and of the serratus posticus were divided, and these muscles were then retracted outward, while the splenius was retracted inward, and the

transverse processes of the vertebræ being exposed, the attachments of the longissimus dorsi were separated from them, and all the deep muscles were detached from the ribs and retracted outward. Portions of the fourth, fifth, and sixth ribs, about three inches in length, were then resected subperiosteally from the tuberosities outward. The layer made up of the periosteum and intercostal muscles was then carefully divided, so as not to injure the pleura, the intercostal arteries being secured as they were severed. The pleura was carefully but widely detached from the contents of the posterior mediastinum and from the posterior chest wall, so as to give access to the root of the lung. The bronchus was easily reached, but it was difficult to expose it, so as to enable an incision to be made into it, on account of the azygos vein which crossed it. The respiratory movements of the lung, heaving under the detached pleura, were also very embarrassing, and finally, as the pulse began to be affected seriously, the wound was packed and the operation suspended.

"The following day the packing was removed, chloroform being given again, and the pleura being now somewhat adherent to the lung and the latter less troublesome, the bronchus was successfully opened on its posterior wall without hæmorrhage. But even then our difficulties were not completely surmounted, for, to our great disappointment, it was found impossible to recognize the foreign body with the forceps introduced into this opening. The foreign body, partly macerated, was similar in consistence to that of the bronchial forks, and it appeared to be farther away from the bifurcation of the trachea than at first. Forceps was also passed down through the tracheal wound, but still the foreign body was not found. Finally, it was detected through the lung by pressing on the latter with the fingers, and it was determined to cut directly down upon it, as even then no forceps could be made to pass to the spot where it lay. The detached parietal pleura was first secured to the surface of the lung by two or three deep silk sutures, the ends of the latter being left long, and the lung being held steady by the threads, an incision was made with the thermo-cautery knife. The foreign body could be felt in this opening, but it still eluded the grasp of forceps, and the condition of the patient forbade any further delay, so a drainage tube was introduced to the bottom of the opening made in the lung and the entire wound packed. Whether the pin was too firmly fixed in the wall of a bronchus, or whether some tissues still remained undivided over it, was impossible to determine, but if the patient had survived, it is probable that the foreign body would have found its way out of the deep wound which led directly down to it. The patient reacted well, and on the following day showed only the ordinary symptoms of a severe pneumonia. Signs of consolidation had been present in the lower lobe of the right lung from the first, and these had increased daily. Fever and dyspnœa, due to this consolidation, gradually increased, and terminated in death about forty-eight hours after the last operation. A post-mortem examination showed no pneumothorax and no pleural effusion. The foreign body lay in one of the secondary bronchi close to the end of the drainage tube, the pin having entirely penetrated the wall of the bronchus."

Curtis turned the base of the flap outward, leaving the soft parts attached to the posterior border of the scapula, thus increasing the thickness and mobility of the base of the flap. He resected the corresponding ribs, lessening a little the time of operation. The employment of the X rays may serve to establish the exact location of the obstruction, thus enabling the surgeon to open the chest at a point nearest to, or at a dependent point in relation with the foreign body, unite the pleural surfaces, reach and remove the object through a canal formed by cautery, or permit of direct removal by means of fine, sharp-pointed, strong pincers passed through the intervening living tissues, as has already been accomplished in at least one instance. The writer submits the following propositions:

1. That, in certain cases, when other means of relief have failed, attempted relief from œsophageal or bronchial obstruction by way of the posterior mediastinum may prove justifiable.

2. That below the arch of the aorta the œsophagus is reached better from the right side; above the arch it can be reached from either, though better from the left side.

3. That the attempted removal of obstructions situated below the body of the ninth dorsal vertebra is not justifiable, owing to the great difficulty and increased danger of exposing the œsophagus at that situation.

4. That posterior entrance to the mediastinum is more easily, quickly, and safely accomplished than the anterior, and offers better results than does the latter method of practice.

The following valuable deductions of Willard, based on experiments on dogs, are worthy of special notice in this connection:

1. The collapse of the lung, when the chest is opened, is an exceedingly serious and dangerous element in the operation, adding greatly to the previous shock, and threatening to overpower the patient.

2. The difficulties of reaching the bronchus, especially upon the left side, are exceedingly great, and the risks of hæmorrhage are enormous.

3. The incision into the bronchus necessarily after closure of the wound of the chest wall leads to increasing pneumothorax.

4. The delays in the operation from collapse of the patient must necessarily be great. Rapid work is impossible when the root of the lung is being dragged backward and forward at least half an inch in the efforts occasioned by air hunger, and precision is almost impossible.

5. To reach the bronchus is sometimes feasible, but to extract a foreign body from it and to secure the patient's recovery is as yet highly problematical, and will require many advances in technique. The anatomical surroundings are those most essential to life.

**Milton's Operation** (*Anterior Thoracotomy*).—Milton's method of entrance to the thorax contemplates the exposure and treatment of the contents of the mediastina, especially the anterior and middle, through an incision made in front at the median line of the chest.

*The Operation.*—Under strict asepsis make an incision in the median line from the thyroid cartilage to the base of the ensiform cartilage, going down to the bone at the sternal part of the cut; expose rapidly the trachea

to a point opposite the episternal notch; detach the fascia from the episternal notch outward at either side to the insertion of the sterno-mastoid muscle; separate and displace downward with the finger from the sternum the important structures lying immediately beneath its upper end; divide the sternum from above downward nearly through along the line of incision in the soft parts with a saw, omitting the ensiform cartilage; disconnect the ensiform cartilage from the bone above with scissors or bone-cutting forceps, carefully avoiding the underlying structures, especially the peritonæum; insert strong, broad-hooked retractors into the sawed border of the sternum at either side of the division and make moderate traction outward and upward; draw downward the ensiform cartilage with a hooked retractor and pass from below upward closely beneath the sternum along the saw line a spatula; complete from below upward the severance of the sternum with scissors or bone-cutting forceps, cautiously protecting subjacent tissues from injury; draw with the retractors and pry apart with a broad chisel the divided borders of the sternum sufficiently to expose restraining tissues, which are cautiously severed with scissors or knife. In this manner a gap two or more inches in width is made through which the anterior mediastinum may be readily exposed to view and examination. Exposure and exploration of the middle and even the posterior mediastinum can now be effected after careful separation of the pericardium from the right pleura. The removal of morbid growths and foreign bodies should be conducted with consummate care, not only to avoid infection and hæmorrhage, but to obviate fatal injury of important structures. Blunt dissection, supplemented with discreet use of cutting implements in the effort, should be practiced. The closure of the mediastinum is easily effected by bringing in contact the sawed borders of bone and firmly wiring them together with five or six silver sutures. After the introduction of gauze drainage at the upper and lower ends of the sternum, the wound of the soft parts is closed and dressed in the usual manner.

*The Precautions.*—For reasons signally apparent the importance of thorough asepsis in each detail of this operation can not be overestimated. Also the intricate relations of highly important structures with each other and with the sternum are such as to demand the closest thought before beginning the operation. Since the division of the sternum and separation of the bone segments arrest costal breathing, ample means for artificial respiration should be at hand to promptly and effectively meet respiratory demands. In emphysematous subjects increased danger of division of the pleura is incurred. If dyspnœa from obstruction is present at the outset, tracheotomy should be performed at once, and provision for the same should be at hand if this complication be anticipated.

*The Remarks.*—The hardest and thickest part of the bone is at the upper end. Separation of the bone segments is easier and safer when begun at the lower end of the sternum, because the intrapleural space is wider (Fig. 1266, dotted lines) and the anatomical relations less important than at the upper extremity (Fig. 200). The chief restraining tissues lie above near the innominate vein and below at the xiphoid junction. Wounds of pleural and

peritoneal membranes, especially the former, should be closed immediately by pressure to avoid pulmonary collapsing and possibly a fatal issue. Immediate artificial respiration should be utilized in lung collapse. Wounds of each of these structures should be closed by sewing as promptly as possible. Morbid processes involving the sternum should be removed when practicable the same as if elsewhere located. The unavoidable amount of hæmorrhage is insignificant.

*The Results.*—The outcome of the several operations by this method commend its further employment, especially when directed to morbid states of the anterior and middle mediastina.

### OPERATIONS ON THE HEART AND PERICARDIUM.

Not until quite recently has this field of operative effort been given the consideration commensurate with its great importance.

*The Anatomical Points.*—The heart corresponds in front to the lower two thirds of the sternum, and parts of the adjacent costal cartilages and of some of the left ribs. Its upper limit is at about the third costal cartilages, its apex at a point located three quarters of an inch within and one inch and a half below the nipple. It extends three inches to the left, and about one inch and a half to the right of the median line of the sternum. Behind the sternum are situated more than two thirds of the right ventricle, the right auricle, a large part of the left auricle, and a portion of the anterior coronary vessels. The base of the heart corresponds at the back to the sixth, seventh, and eighth dorsal vertebræ. The anterior portion of the pericardium above, lies from three to five centimetres (one and two tenths to two inches), and below about one centimetre (four tenths of an inch) behind the sternum. At the base of the pericardial sac anteriorly there is a *cul-de-sac* (*a*) of from one to two centimetres (four to eight tenths of an inch) in depth, normally collapsed, but distended in the event of pericardial effusion, when it corresponds to the region of the sixth intercostal space (Fig. 1263). Toward this *cul-de-sac* (*a*) are the efforts of the operator directed in aspiration and in drainage of the pericardium. The distended pericardium extends above to the first space, below to the seventh cartilage, to the right from two to three centimetres (eight tenths to one and two tenths inches) beyond the edge of the sternum, and to the left a little beyond the normal line. At the interpleural space the pericardium can be entered without involvement of the pleura. This space corresponds to the lower triangular portion of the anterior mediastinum, and is bounded on either

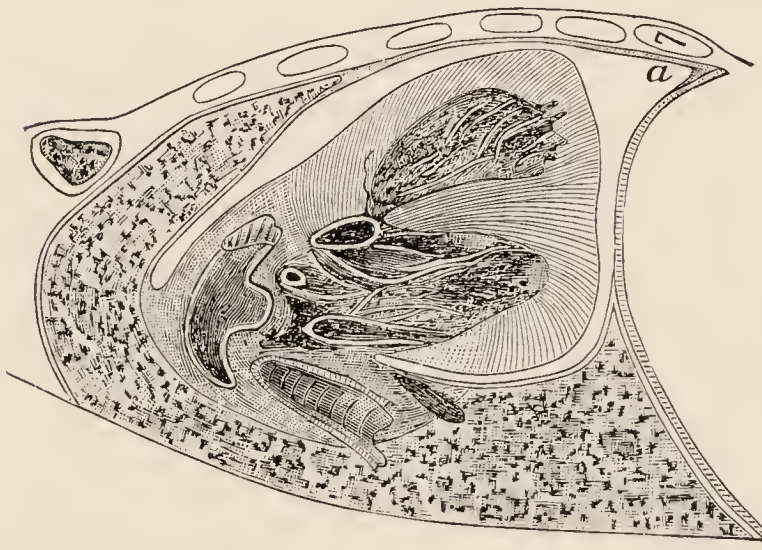



FIG. 1263.—Vertical section showing relations of the heart and a considerable pericardial effusion to the parietes; reclining. *a. Cul-de-sac.* *7.* Seventh costal cartilage.

side by the respective anterior pleural reflections, and below by the diaphragm (Fig. 1264).

The exact location and size of this space vary. Right pleural adhesions or a left pleurisy with effusion, carries the space to the right of its normal position, and *vice versa*. Adhesions of both pleuræ increase the size

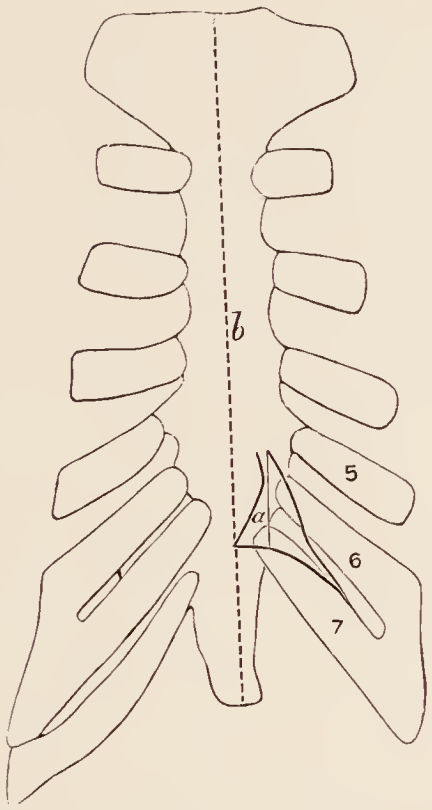



Fig. 1264.—Composite normal interpleural space of Voïnitch-Sianojentsky. *a*. Resultant line of greatest safety. *b*. Median line. *5*, *6*, *7*. Fifth, sixth, and seventh costal cartilages.

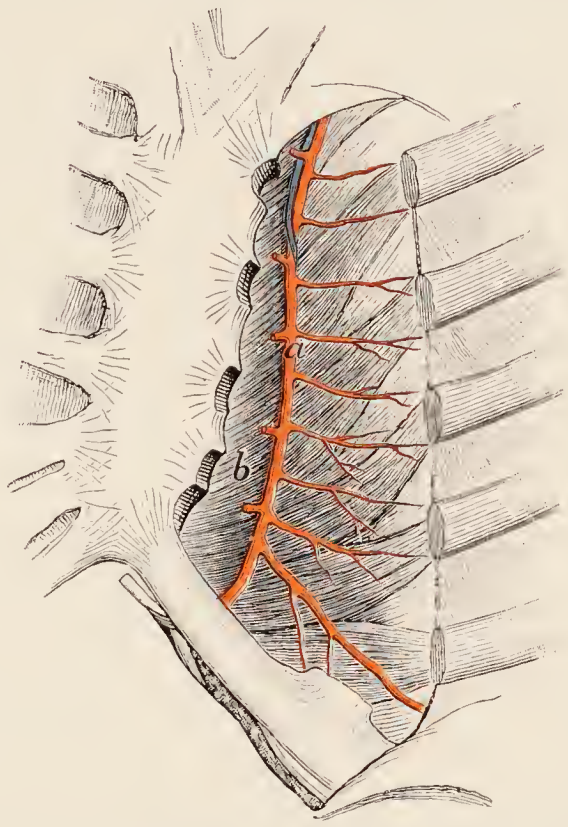



Fig. 1265.—Internal mammary artery lying on triangularis sterni muscle. *a*. Artery. *b*. Muscle.

of the interpleural space, while a double pleurisy with effusion diminishes the space and presses the pericardium backward. In abdominal distention the diaphragm or lower boundary of the interpleural space is pushed upward, so that a puncture of the fifth space might enter the abdominal cavity. A pericardial effusion, other things being equal, tends to increase the size of the interpleural space. The anterior pleural folds are loosely adherent to the pericardium, from which they can be stripped, but intimately bound to the triangularis sterni, from which they can not be separated. A ridge of dense cellulo-adipose tissue designates the line of pleural reflection. The triangularis sterni underlies the sternum and costal cartilages. Upon it rests the internal mammary artery (Fig. 1265), which above lies from one half to one and a half centimetres (two to six tenths of an inch), and below from one to two centimetres (four to eight tenths of an inch) from the sternal border. A cartilaginous bridge unites the sixth and seventh costal cartilages (Fig. 1266, *d*), and sometimes one exists also between the fifth and sixth. The sixth space near the sternum is a very narrow one, and is sometimes obliterated.

**Aspiration of the Pericardium.**—This operation is performed for hydropericardium, hæmopericardium, and for diagnosis in suspected pyopericardium. The needle should be a very fine one for diagnosis. That of *Pravaz* is much employed. Evacuation should be done with a *Potain* apparatus and a needle or trocar.

*The Important Facts.*—Involvement of the pleura and injury to the heart and internal mammary vessels should be avoided. The determination anteriorly of a composite pericardial area not covered by pleura in any one of a large number of normal subjects has been made by Voïnitch-Sianojentsky (Fig. 1264). The long axis of this space which would be the resultant site of greatest safety extends from the seventh left chondro-sternal articulation vertically upward to the level of the lower border of the fifth chondro-sternal articulation. This line lies chiefly behind the sternum but touches upon the sixth space, just at the sternal margin. The same investigator likewise demonstrates the relation of the heart surrounded by a considerable effusion to the chest wall (Fig. 1263). This illustrates how puncture in the sixth space can be made direct, and also that in puncture through the fifth space the puncturing agent should be directed very obliquely downward to avoid injury to the heart. The mammary vessels can be avoided by puncturing close to the sternum or well external to them.

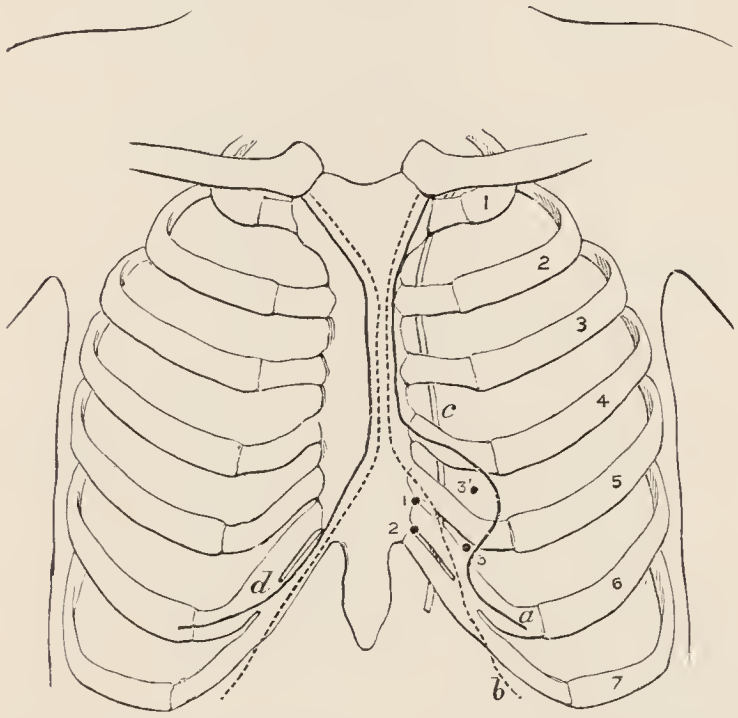



Fig. 1266.—Aspiration of the pericardium. *a*. Anterior edge of lung. *b*. Border of pleura. *c*. Internal mammary artery. *d*. Cartilaginous bridge between sixth and seventh cartilages. *Sites of Puncture.*—*1*. Baizeau and Delorme. *2*. Delorme and Mignon, also Voïnitch-Sianojentsky. *3*, *3'*. Dieulafoy. Dotted lines correspond to borders of pleura.

*The methods of aspiration* are those of Delorme and Mignon, of Baizeau and Delorme, of Voïnitch-Sianojentsky, and of Dieulafoy (Fig. 1266).

*Delorme and Mignon.*—Make a vertical incision at the left border of the sternum over the fifth and sixth intercostal spaces. Introduce the needle preferably in the sixth space, but if this space is too narrow, through the fifth, close to the sternum for about eight millimetres (three tenths of an inch), corresponding to the thickness of the bone; then direct the needle inward close to the posterior surface of the sternum for one or two centimetres (four or eight tenths of an inch), to avoid the pleura, after which raise the handle of the instrument a little and plunge the needle downward and inward through the pericardium.

*Baizeau and Delorme* (*1*).—Through a short skin incision plunge the needle obliquely downward and inward in the fifth left intercostal space, close to the sternum, until the pericardium is reached and entered.

*Voïnitch-Sianojentsky* (*2*).—Pass the needle directly from before backward in the sixth left intercostal space close to the sternum.

*Dieulafoy* (*3*).—Aspiration is made through the fourth or fifth space, preferably the latter, at a point about six centimetres (two and four tenths inches) from the sternal margin. Entering by a short vertical incision pass the point of the needle carefully through the intercostal muscles, after which

direct the instrument obliquely inward, almost parallel with the inner surface of the chest wall. The tense surface of the pericardium is detected and the instrument passed through it. The point of the instrument should be carefully held downward and inward, flattened against the pericardial sac to prevent injury of the heart.

*The Remarks.*—*Lejars* recommends the method of Baizeau and Delorme for diagnostic puncture. The objections to the method of Dieulafoy are that the instrument always passes through the pleura, and that the heart, from its relation with the fifth space, is liable to be injured. Owing to the pleural involvement, aspiration should never be practiced here for pus.

*The Results.*—The results of aspiration in hæmorrhagic pericarditis, where the general condition is not too unfavorable, are good. In pericarditis with effusion the results vary according to whether the fluid is of a tuberculous or of a rheumatic origin. Early aspiration here is better than late. In the hydropericardium of Bright's or cardiac disease, aspiration can be only a palliative measure.

**Pericardiotomy.**—Pericardiotomy is performed for exploration in wounds of the pericardium, for suture of wounds of the heart, and for drainage of pus.

*The Operation.*—Make either an ⌶-shaped incision (Fig. 963) or a single oval incision with its base at the sternum. The vertical portion of the former should lie a finger's breadth external to the left border of the sternum, and extend from the upper border of the fourth to the lower border of the sixth or seventh cartilage. The fifth cartilage is always resected, and the sixth and fourth also may be if more space be needed. Cut the intercostal muscles close to the sternum and reflect the flap outward, exposing the internal mammary artery beneath. The latter may either be ligated, or else drawn outward together with the triangularis sterni and the left pleural reflection, after the dissection of these structures from the sternum and pericardium respectively. Incise the pericardium from below upward between two forceps to avoid injury of the heart. Drain at the lower angle of the wound. In suture of the pericardium bring serous surfaces into apposition.

*The Remarks.*—This operation is practically that of Delorme and Mignon. Voïnitch-Sianojentsky has proposed three operations for drainage of a small, a medium, and a large effusion respectively, aiming his point of entrance at the interpleural space which he found enlarged progressively toward the left with the increase in pericardial fluid. For a small effusion he would resect the left sixth and seventh cartilages close to the sternum, together with the adjacent portion of the sternum, and sew the pericardium to the aponeurotic opening in the triangularis sterni. For a medium effusion he would resect the left sixth and seventh cartilages adjacent to the sternum without resection of the sternum itself, tying the internal mammary artery; and for a large effusion he would resect the sixth left cartilage external to the internal mammary artery.

**Wounds of the Heart.**—Wounds of the heart are not so infrequent or so fatal as is commonly supposed. Death may happen instantly or be delayed

for many months. *Fischer* collected 452 cases with 84.07 per cent mortality; 104 of these cases suffered immediate death. *Loison* reports 277 cases of the past thirty years, with 84.8 per cent mortality. *Jamain* reports 121 cases, of which 18 per cent died immediately, 69 per cent died after an interval of more or less time, and 13 per cent recovered. *Laforgue* reports 56 cases, of which 32 per cent died immediately, 38 per cent survived for a longer or shorter period, and 30 per cent recovered. Loison reports 23 cases of needle wound of the heart with 14 deaths, of which 1 only was from infection. Eight deaths certainly, and probably the others, were from tearing of the heart, and in all there was distention of the pericardium. The right ventricle, from its anterior position, is the part most often wounded. The auricles, especially the left, may be wounded from the back. In a wound of the heart the pleura is almost always involved, producing a left hæmothorax. *Rehn* and *Bode* claim that small wounds of the heart tend to heal rapidly, while large wounds remain gaping, having a tendency to enlarge in the direction of the muscle fibers.

In estimating the possibility of injury of the heart from penetrating agents, the seat, depth, and direction of the wound are of the greatest importance. These facts, when supplemented by a knowledge of the established relations of the organ to the chest wall, enable one to judge quite accurately by local evidence only if the heart be wounded.

When the local characteristics of the wound suggest that the heart is involved, absolute quiet, in as comfortable a posture as possible, should be enjoined and secured if practicable by anodynes. If symptoms are present or supervene indicating labored action of the organ from impaired force due to injury, or to direct pressure from pericardial extravasation of blood, the heart's power should be stimulated and the labor lessened by removal of the extravasated fluid and the arrest of hæmorrhage. *Paget* reports a case of stab wound complicated with great distention of the pericardium by blood, and attended by severe suffering, in which a successful issue followed phlebotomy. The patient's condition improved, the profound sense of suffocation diminished as the escape of blood progressed to the estimated amount of two pounds. Should bleeding fail to afford relief, and evidences of increasing escape obtain, the removal of the compressing fluid by tapping or incision of the pericardium under local anæsthesia is indicated, followed possibly in the latter instance by repair of the wound itself (page 1059). If blood escape from the pericardial wound the latter should not be tamponed, since not only is the circulation depleted by the flow, but also the danger of compression of the heart is diminished by it.

In the instance of needle wounds the onset of the symptoms is less acute, more slowly progressive, and not so dangerous as in wounds from grosser agents. A simple puncture of the heart is comparatively harmless, but when a needle is left with one end fixed in the thoracic wall and the other planted in the pulsating heart a gradual tearing of the cardiac muscle takes place. Immediate extraction is therefore indicated. The detection of the point of penetration, and of the needle itself, by means of the X rays, call

for explorative examination and removal. The needle should be removed with a slow, steady, rotatory movement.

*The Suture of Wounds of the Heart.*—The heart has been sutured six times in man, twice successfully, once by *Rehn*, who sutured a wound of one and a half centimetres (six tenths of an inch) in the right ventricle with three silk sutures, and once by *Parozani*, who sutured a wound of two centimetres (eight tenths of an inch) at the apex with four sutures. *Giordani* sutured a wound of two centimetres (eight tenths of an inch) in the left auricle with four sutures, and found the wound in the process of cicatrization at autopsy, death having resulted on the nineteenth day from empyema.

A curved intestinal needle is used. It is carried deeply into the cardiac muscle, entering and emerging on either side of the wound at least four or five millimetres (one tenth and a half or two tenths of an inch) from its edges, and should never penetrate the endocardium. It is passed rapidly during diastole, which is perceptibly lengthened by the manipulation. At a succeeding diastole the thread is drawn through, and at another tied. Traction on the first stitch facilitates the introduction of the successive ones by steadying the heart. It is best to suture all wounds of the heart. The coronary artery if wounded should be tied.

## OPERATIONS ON THE NECK.

**Bronchotomy.**—The expression bronchotomy includes four distinct operations: *laryngotomy*, *tracheotomy*, *laryngo-tracheotomy*, and *thyrotomy*, the first two of which are still further classified. These operations are comparatively easy in the adult, especially if the neck be long and thin, and the landmarks well developed. In the infant and the child, and before puberty —the periods of life when they are most demanded—their performance is difficult and perplexing, owing to the shortness of the neck, obesity of the patient, the rudimentary condition of the landmarks, and the exigencies of the occasion.

*The Anatomical Points.*—The trachea in the adult is about four inches and a half in length and three quarters of an inch from side to side. The distance between the sternum and the cricoid cartilage is about two and three quarter inches in the adult, and two and a quarter, two, and one and a half at ten, seven, and five years respectively. The following illustrative scheme (Treves) shows the relation between the respective ages and sizes of the corresponding tubes (Fig. 1267):

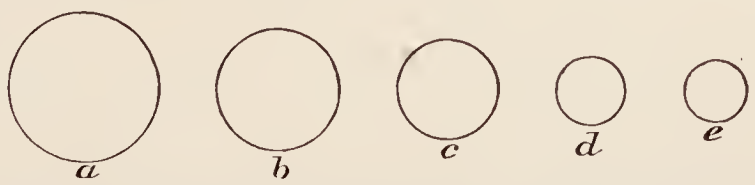



FIG. 1267.—Comparative diameters of tracheotomy tubes based on age of patients. *a*. .47 + inch (12 mm.), twelve to fifteen years. *b*. .40 — inch (10 mm.), eight to ten years. *c*. .31 + inch (8 mm.), four to eight years. *d*. .24 — inch (6 mm.), two to four years. *e*. .20 — inch (5 mm.), one and a half to two years. Adults, $\frac{1}{2}$ to $\frac{3}{4}$ inch; under one year and a half, .15 + inch.

The thyroid cartilage (Fig. 1268, *c*), which is well marked in the adult, constituting a prominent point of reckoning, is scarcely discernible in the child,

and in the infant it is quite impracticable to determine its location by physical examination. The cricoid cartilage (*e*) is a far better guide by which to determine the comparative relations of the parts. It is the distinctive cartilage of the laryngeal group, and, irrespective of age, it can be felt as a firm, round ring, much more prominent than the cartilaginous rings of the trachea, which lie immediately below it. The crico-thyroid space (*d*), through which in laryngotomy the deep incision is made, is located immediately above the cricoid cartilage (Fig. 1268). This space is situated at the bottom of the first groovelike depression above the cricoid cartilage. The crico-thyroid membrane (*d*) is composed of yellow elastic tissue, is therefore of a yellowish appearance, and is often dotted by openings for small vessels. When incised it will retract, owing to its resilient nature; hence all hæmorrhage should be stopped before it is opened if the urgency of the case will permit. It is not difficult to locate the guides in the dead subject under ordinary circumstances; but in the living, when they are being jerked upward and downward by the efforts of impeded respiration, it is a matter of great difficulty, and may be impossible. The only artery normally in the line of the operation of laryngotomy that need be respected is the crico-thyroid (Fig. 1269, *d*); it runs along the upper border of the space, resting on the membrane of the same name. This artery is troublesome, not from the amount of blood it contains, but from its relation to the opening in the membrane through which a small amount of blood may pass into the tube. The vessels causing the greatest annoyance —especially if the patient be much cyanosed —are the small venous trunks which run across the tracheal and laryngeal region, without any definitely established relationship, and which return their blood chiefly into the superior thyroid veins (Fig. 1269). The anterior jugular veins will be troublesome unless the median line be adhered to closely. It is unnecessary, I trust, to allude to the well-known relation between the larynx and the large vessels of the neck. The thymus gland in the very young deserves respectful manipulative consideration. The innominate and common carotid arteries, especially in the right, may encroach on the operation in low tracheotomy.

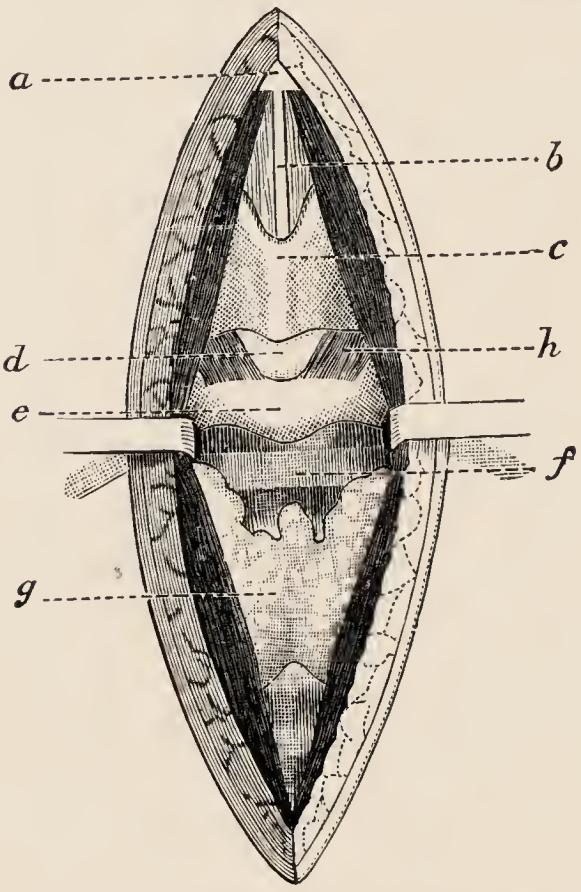



FIG. 1268.—The topography of the larynx, etc. *a*. Body of hyoid bone. *b*. Thyro-hyoid membrane. *c*. Thyroid cartilage. *d*. Crico-thyroid membrane. *e*. Cricoid cartilage. *f*. First tracheal ring. *g*. Isthmus of thyroid body, with tracheal rings below. *h*. Crico-thyroid muscle.

*The anæsthetic* to be given in operations where the respiratory function of the larynx is involved is a matter entitled to careful consideration. For instance, if ether be given to one who has no laryngeal irritation or obstruction, the frequent spasm of those parts is familiar to all. If to this be added the deficient aëration of the blood, due to a laryngeal obstruction, together

with the increased tendency to spasm, dependent on laryngeal disease and to fright, then is the danger of asphyxia greatly augmented. Chloroform may be given with but little danger of causing spasm; if ether be administered, it must be commenced very gradually, to avoid as much as possible the occurrence of laryngeal spasms. In many instances the pressing nature of the case will not permit the expenditure of the time necessary to produce general anæsthesia. Local anæsthesia may be employed. In those cases presenting marked cyanosis the sense of pain is much blunted and the operation should be done without anæsthesia. *The instruments* suitable for these operations (Fig. 1270) are quite numerous, yet the absence of any one or more of them is not to be considered a reason for non-performance of bronchotomy when demanded. When necessary, a pocketknife, and a hairpin, a toothpick, or a catheter (Fig. 1270) can be extemporized to advantage, thus preventing the death of the patient unaided because a tracheotomy tube is not obtainable.

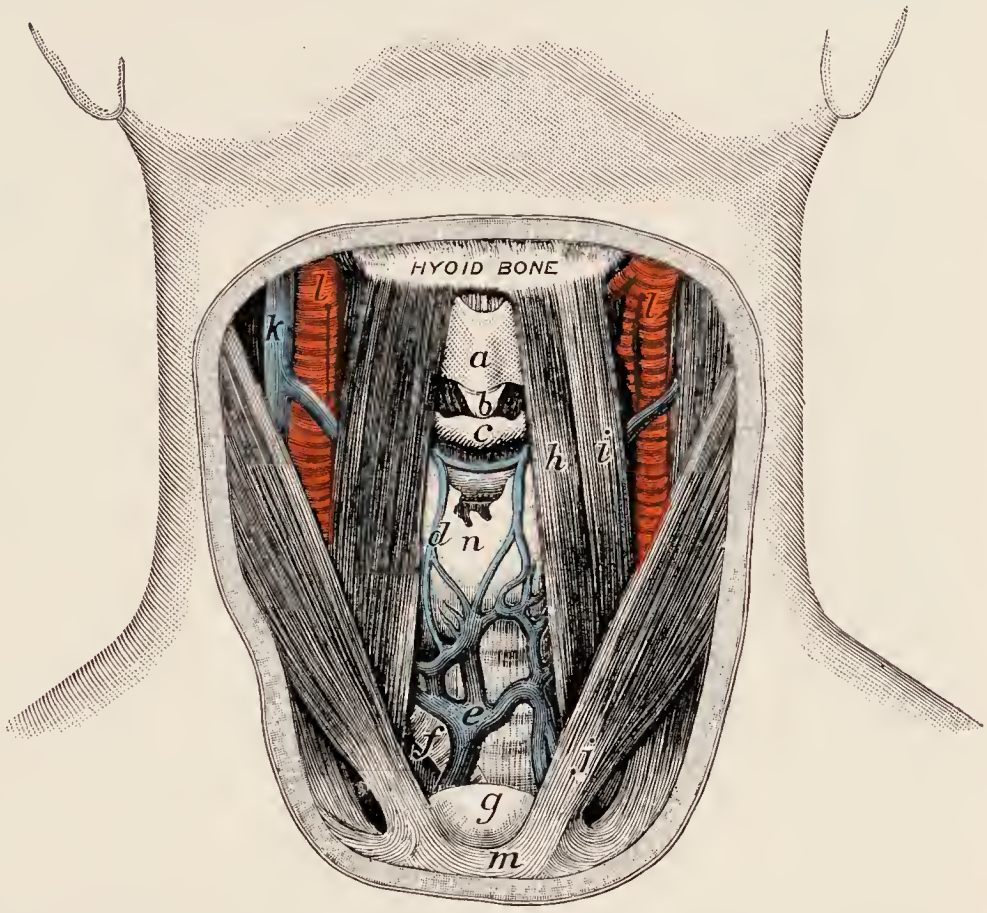



Fig. 1269.—The surgical anatomy of larynx and trachea. *a.* Thyroid cartilage. *b.* Crico-thyroid membrane and artery, crico-thyroid muscle at either side. *c.* Cricoid cartilage. *d.* Superior thyroid vein. *e.* Inferior thyroid vein. *f.* Innominate artery. *g.* Thymus gland. *h.* Sterno-hyoid muscle. *i.* Omo-hyoid muscle. *j.* Sternal attachment of sterno-mastoid. *k.* Jugular vein and branches. *l, l.* Carotid arteries and branches. *m.* Sternum. *n.* Thyroid body.

Langenbeck's hook (Fig. 1271) is the best in use, because the line of the cut can be made between its blades, and the middle line of the trachea is therefore the better assured. There are various forms of tracheotomes, which should not, in our opinion, be substituted for the sharp-pointed bistoury, because they are much less surgical in their inception and far more dangerous in their use. Trachea dilators, too, are quite numerous and varied in pattern (Fig. 1270, *p*, *q*, *r*). The borders of the tracheal opening can always be easily drawn apart by common tenacula or by two of the ordinary grooved directors with aneurism-needle attachments (Fig. 1270, *e*). The bivalve trachea tube is an admirable instrument, since it can be introduced through the opening in the trachea much more readily than the ordinary blunt-ended pattern, and can be quickly opened afterward by the introduction into it of the companion tube (Fig. 1270, *n*). A long feather, with the end of the brush remaining (Fig. 1270, *u*), should be at hand to insert




FIG. 1270.—Instruments employed in operations on the trachea.

*a*. Scalpels, sharp and probe pointed. *b*. Scissors, curved and straight, blunt pointed. *c*. Forcipressure. *d*. Mouse-tooth forceps. *e*. Directors with hooked extremities. *f*. Blunt hook. *g*. Strong tenaculum. *h*. Two-tined retractor. *i*. Small blunt retractor. *k*. Rubber tracheotomy tube with tapes attached. *l*. Hard-rubber tube. *m*. Gussenbauer's tube. *n*. Bivalve tube. *o*. König's tube. *p*. Trousseau's trachea dilator. *q*. Tiemann's dilator. *r*. Chassaignac's dilator. *s*. Hairpin, pocketknife, and female catheter. *t*. Trachea forceps. *u*. Feather for introduction to trachea. *v*. Trachea forceps. *w*. Trachea aspirator. *x*. Ligatures, traction loops, and sutures. Spatula, mouth gag, tongue forceps, wipers, and shield, for mouth and eyes of operator in diphtheria, ought to be at hand. Genzmer's modification of König's tube (*o*) is valuable.

through the tube into the trachea, to create the irritation sometimes necessary to cause the expulsion of the tracheal mucus. A so-called trachea aspirator has been devised to remove mucus and blood from the trachea (Fig. 1270, *w*). It is used as follows: After the insertion of the trachea tube, place the thumb on the air hole of the barrel; apply the soft-rubber cup over the tube, and withdraw the piston, when the mucus and blood will enter the barrel. It has not infrequently happened that a patient is unable to expel the blood and mucus on account of stupor or weakness, and the lips of the operator were used to clear the trachea. This is obviously a hazardous procedure if the patient have syphilis or diphtheria. The possession of the tracheal aspirator will be welcomed as preferable under all circumstances. A serviceable instrument for the purpose of removing blood, etc., from the trachea tube, and even from the trachea itself, can be quickly extemporized by attaching to the nozzle of an ordinary two-ounce rubber syringe a soft piece of rubber tubing five or six inches in length. The unattached end of the rubber tubing is inserted into the trachea tube or into the trachea itself; the piston of the syringe is withdrawn somewhat quickly, and the fluid sucked up. If the suction be made too quickly the tube will be collapsed and inoperative. Large portions of membrane have been drawn by the writer from the bronchial tubes in this manner.

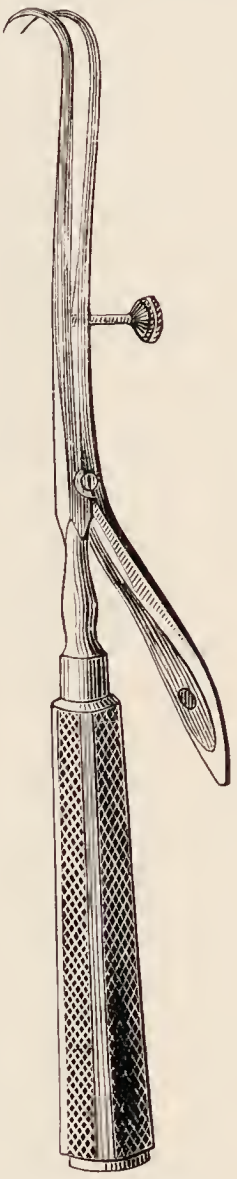


FIG. 1271.
Langenbeck's double hook.

*The After-treatment.*—The soft parts above and below the tube are closed by sutures and the patient is then placed in bed and caused to breathe air saturated with warm vapor from which all floating particles of dirt should be excluded. The tube is carefully watched to prevent it from becoming closed, and occasionally removed and cleansed to prevent wound and pulmonary infection. Too great emphasis can not be laid upon the necessity of instantly relieving the sudden occlusion of the tube due to false membrane. For this reason a momentary inattention, as leaving the room, etc., may prove fatal to the patient. After three or four days the tube may be removed and the patient allowed to breathe through the opening for a few hours, after which the tube should be again inserted; later in the case it may be inserted only during the night. As soon as the patient can breathe well, the tube should be removed entirely, the opening cleansed, and the borders closed, joined by sutures. If antiseptic gauze (not bichloride) be placed between the surface of the neck (Fig. 1275) and the flanges of the tube, the danger of irritation of the soft parts at that situation by the discharges will be obviated.

**Laryngotomy.**—Although all operations in which the larynx is opened are included under the name laryngotomy, for convenience of expression limited divisions of the organ are named for the part divided—i. e., thyrotomy, cricotomy (Figs. 1272 and 1273), etc.

*The Operation.*—Place the patient on the table with the shoulders elevated, head thrown back, and neck exposed to a strong light. If hurried, a

round bottle or loaf of bread or block of wood may be placed under the neck, or if the head hang supported over the edge of the bed or table, the object will be gained. At least three assistants are required, especially if an anæsthetic be given. Locate the cricoid cartilage; support the larynx firmly between the thumb and finger of the left hand; make an incision through the integument one inch and a half in length in the adult, terminating at the lower border of the cricoid cartilage; divide the fascia on a director; divide the connections between, and separate the borders of the sterno-hyoid (Fig. 1269) muscles with retractors; push aside the veins and connective tissue and the crico-thyroid membrane will be seen (*b*).

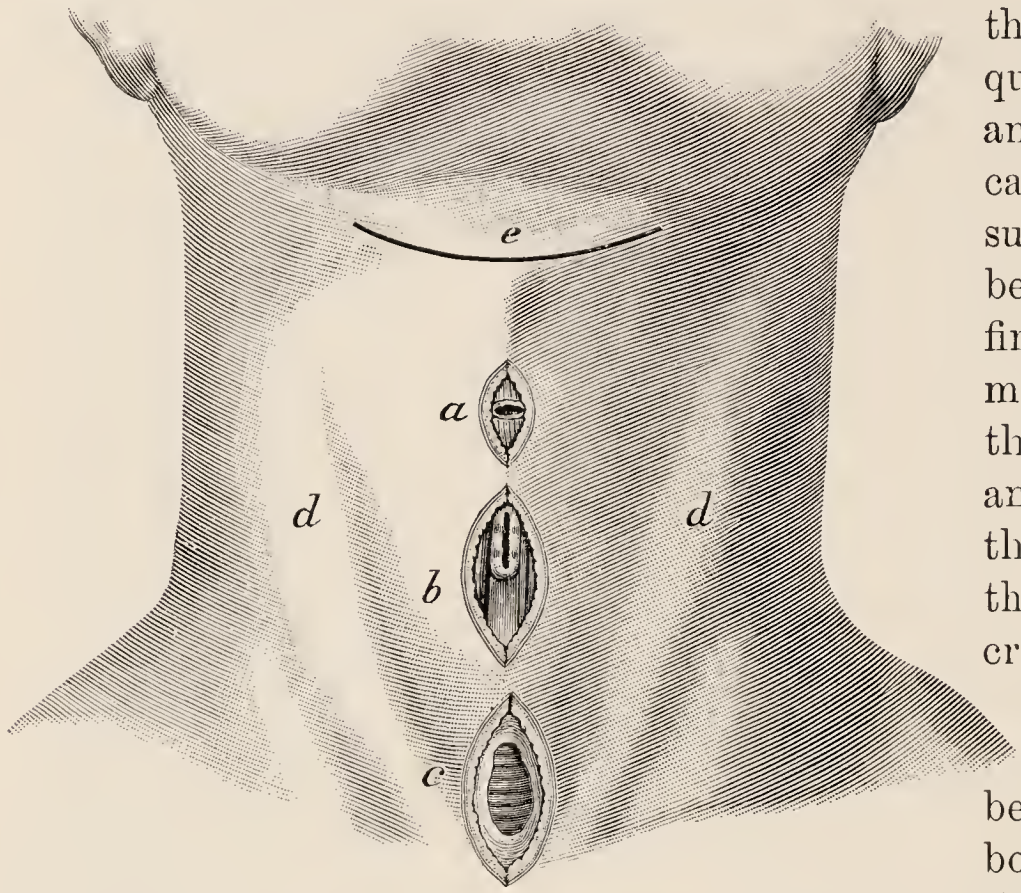



FIG. 1272.—*a*. Incision in laryngotomy. *b*. Incision in tracheotomy above the isthmus of the thyroid body. *c*. Incision in tracheotomy below the isthmus of thyroid body. *d*, *d*. Sterno-cleido-mastoid muscles. *e*. Incision in subhyoid pharyngotomy.

If the case be not urgent, check all hæmorrhage before opening the larynx. If otherwise, open it at once, when the entrance of air and the resumption of the respiratory functions will dispel the cyanosis and check the bleeding. The larynx is seized and held firmly upward and forward by the tenaculum, while the opening is made through the crico-thyroid membrane, transversely near the upper border of the cricoid cartilage, both to avoid the crico-thyroid artery, which runs along the upper border of the membrane near the thyroid cartilage, and also to remove the tube as far as possible from the vocal cords. The whistling of the ingoing air, succeeded by an expulsive cough—which ejects the mucus, blood, and other matters—follow quickly after the incision. If the operation be performed for the removal of a foreign body it may at this time be expelled, or become lodged near the opening, when it can be removed by forceps. If the operation be performed for laryngeal diphtheria, the tube should not be inserted until all loose membrane has been expelled, and such as may be within reach of the forceps has been pulled away. If blood escape into the opening from the oozing vessels, the pressure of the tube upon the lips of the wound will serve to check it, and for this reason it may be introduced promptly. The tube is carried carefully in while the borders of the opening are held apart with the orthodox retractors, or by means of two blunt artery needles or tenacula, after which it is fastened in position by means of tapes carried around the neck and tied behind (Fig. 1275). If the opening be too

small, it may be increased by division of the cricoid cartilage (*crico-laryngotomy*).

**Tracheotomy.**—The operation of tracheotomy consists in opening the trachea, and is usually performed upon children, owing to the small size of their crico-thyroid spaces. It is the preferable operation in all instances when the incision is to be made as far as possible from a contagious local disease. *Tracheotomy may be done at three situations*—below (Fig. 1272, *c*), above (*b*), and behind the isthmus of the thyroid gland; the operation below the isthmus is to be preferred.

*The Anatomical Points.*—The upper portion of the trachea is quite superficial, while the lower is from half an inch to one inch below the surface, depending upon the shortness of the neck and the obesity of the patient. The lower portion recedes, following the curve of the spinal column. The vascular structures associated with this portion are far more important and numerous than in other parts of its course; the inferior thyroid veins (Fig. 1269), and their communications, pass in the course of the incision; the arteria thyroidea ima when present runs along the center of the trachea; the arteria innominata, especially in the child, runs obliquely across it, at the root of the neck from left to right. The isthmus of the thyroid covers the second, third, and often the fourth rings of the trachea; above it is seen the communicating branch between the superior thyroid veins (Fig. 1269); the thymus gland, which attains its full size at two years, encroaches upon the space from below upward with each labored respiratory act, and may be incised. *It is sometimes difficult* for the beginner, when surrounded by the turmoil incident to the operation, to be certain of the location of the trachea. If the index finger be inserted into the wound the trachea will roll under it, and be felt ascending and descending beneath its extremity, and, when sufficiently isolated, the rings can be seen and felt. Also, the inexperienced operator is likely to open the trachea at one side of the median cut, making it difficult to introduce the tube, causing it to bind after introduction, and not infrequently, if the tissues overlap the cut before its introduction, causing air to be forced between their planes, creating local emphysema. If the knife be inserted too far, the posterior wall of the trachea will be divided.

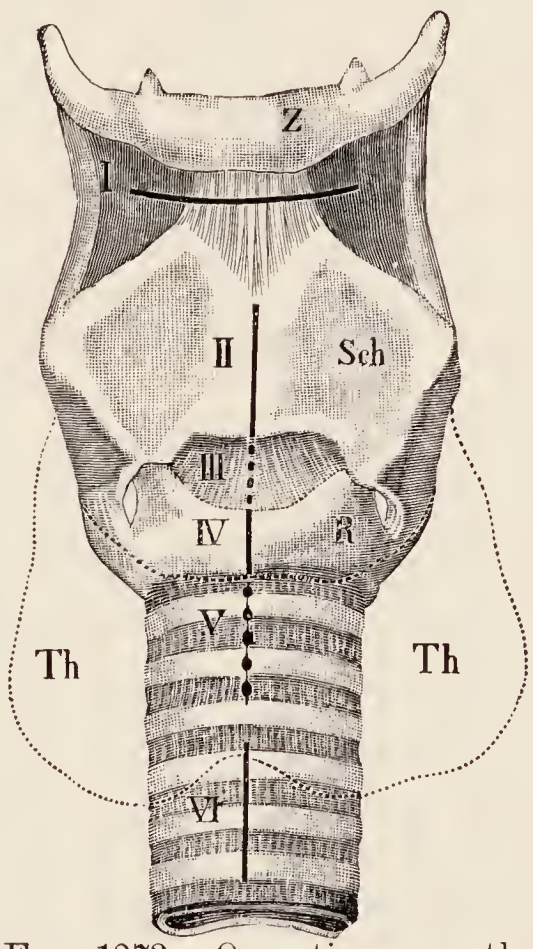



FIG. 1273.—Operations on the larynx. *Z.* Hyoid bone. *Sch.* Thyroid cartilage. *R.* Cricoid cartilage. *Th.* Outline of the thyroid gland. *I.* Subhyoid pharyngotomy. *II.* Thyrotomy. *III.* Infrathyroid laryngotomy. *IV.* Cricotomy. *V.* High tracheotomy. *VI.* Low tracheotomy.

*The Operation below the Isthmus* (Low Tracheotomy, Figs. 1272 and 1273).—Place the patient as for laryngotomy, and, if practicable, employ an anæsthetic. Support the trachea in the median line, and make an incision extending from the cricoid cartilage to within half an inch of the top of the

sternum; divide the fascia on a director; cautiously separate and pull aside the sterno-thyroid and sterno-hyoid muscles, thus exposing the deeper cervical fascia, beneath which are located the inferior thyroid veins (Fig. 1269), supported by connective tissue. This fascia should be torn asunder by a blunt instrument, and pushed aside along with the veins and connective tissue beneath, which will expose the trachea. The blunt ends of two ordinary directors can be utilized for separating the fascia, or instruments especially devised for dry dissections can be employed (Fig. 42). Throughout the entire operation the tissues must be drawn asunder as fast as separated, by means of blunt hooks or other form of retractors, to afford ample exposure of each succeeding part. As soon as the trachea is reached, and all hæmorrhage checked, it is seized by one or two hooks—the double hook of Langenbeck (Fig. 1271) being the best—drawn forward to near the surface of the wound, firmly held, and three or four rings of the trachea divided exactly in the median line from above downward, or better from below upward, by a sharp-pointed knife (Fig. 1274). Then the dilator (Fig. 1270) is introduced, and the tube inserted and confined in position after the tracheal mucus and blood have been expelled (Fig. 1275). All incisions, except the primary one, should be directed upward to avoid the great vessels at the root of the neck. The opening in the trachea should be long enough to admit the easy expulsion of all false membranes and foreign bodies (an inch in length is not too much for this purpose), and must likewise readily admit the trachea tube.

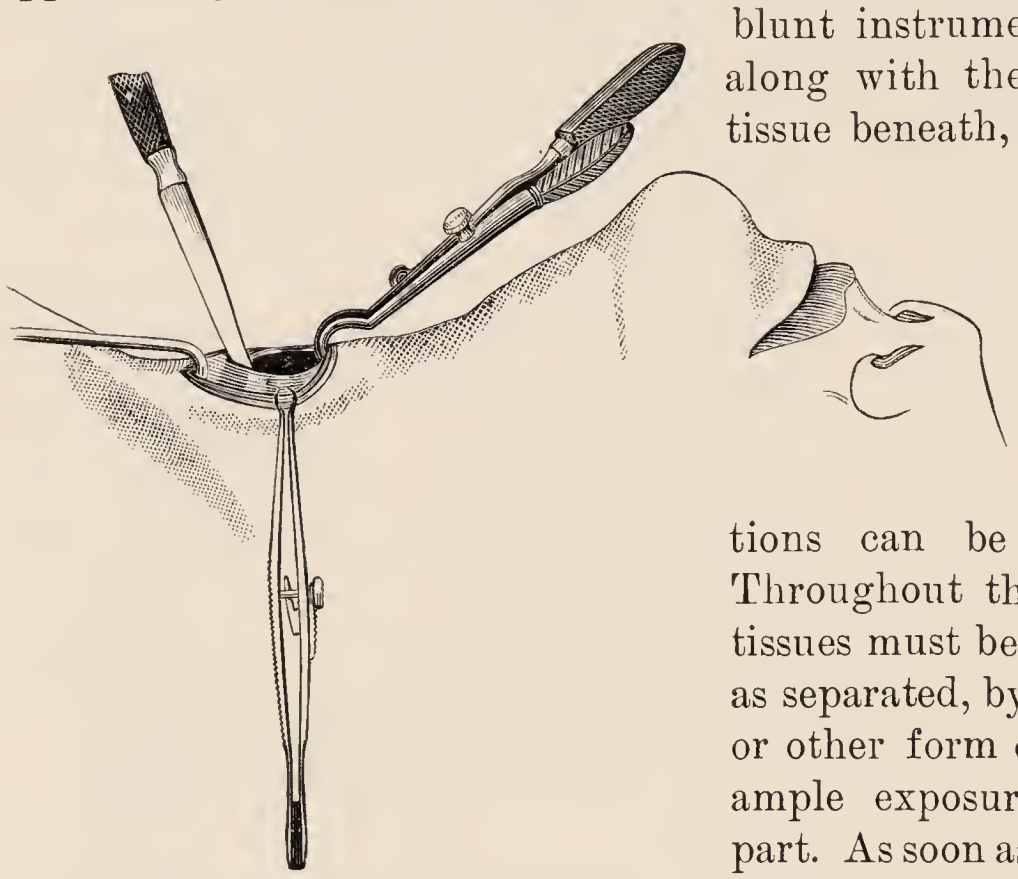


Fig. 1274.—Opening the trachea.

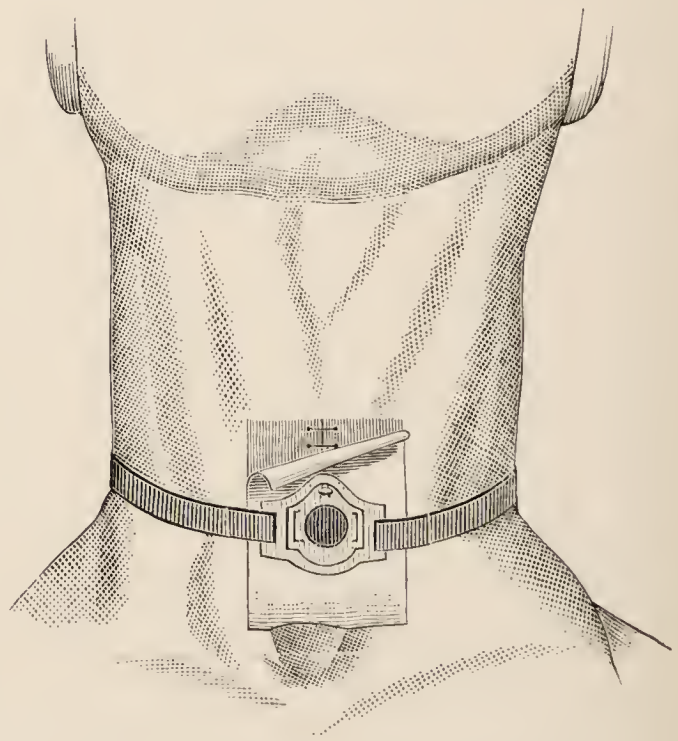


Fig. 1275.—Tube in position.

*The Operation above the Isthmus* (High Tracheotomy, Figs. 1272 and 1273).—Make an incision of the usual length, its center corresponding to the lower border of the cricoid cartilage (Fig. 1272, *b*); divide and carefully separate the tissues as before; the loop of communication between the superior thyroid veins (Fig. 1269) must be carefully drawn upward, the fascial attachment between the isthmus and

the cricoid cartilage divided, the isthmus pulled downward and drawn forward by a blunt hook, when the trachea can be opened beneath it from below upward, and the tube inserted with the same precautions as before.

*The Operation through the Isthmus.*—This method is hardly of enough practical importance to be entitled to a detailed consideration, since the opportunities afforded above and below it will be sufficient. If, however, this position be selected for operation, the isthmus should be divided between two ligatures to avoid the probability of troublesome hæmorrhage. It sometimes happens that the isthmus is small or too illy developed to be troublesome after its division without ligature.

**Laryngo-tracheotomy.**—In laryngo-tracheotomy the larynx and trachea are both opened by a continuous incision, which is usually made to increase the space, that foreign bodies and false membrane may be removed. The incision through the cricoid cartilage and upper rings of the trachea is then secondary to the opening of the larynx. Before the primary incision is extended, the communicating branches of the superior thyroid veins should be pulled downward, the lower border of the cricoid exposed, the fascial connections of the isthmus to it severed, and the isthmus drawn downward and forward as before, to prevent it from being injured.

**Rapid Laryngo-tracheotomy** (*Saint-Germain*).—It is sometimes necessary to open the larynx very quickly; therefore, it is quite proper to mention some of the points connected with this operation that the surgeon may be prepared to act with dispatch combined with caution.

*The Operation.*—With the patient placed in the usual position for tracheal operations, the surgeon locates the thyroid and cricoid cartilages and the space between them. Then, standing on the right side of the patient, he seizes and pushes forward the larynx by pressing the thumb on one side and index finger on the other, between it and the vertebral column, thereby making the integument tense. At the same time the index finger locates the lower border of the thyroid cartilage. A straight, sharp-pointed bistoury is then seized between the thumb and index and middle fingers, its back upward, with the middle finger so placed on the blade that the knife can not penetrate to exceed half an inch in depth. While thus held, its point is quickly thrust into the larynx in the median line at the lower border of the thyroid cartilage and the blade is carried downward with a sawing motion, dividing the crico-thyroid membrane, cricoid cartilage, and one or two rings of the trachea. The opening through the integument should equal in length the one made in the larynx and trachea. The dilator is introduced, all bleeding checked, and the tracheal tube placed in position. Saint-Germain up to 1877 had operated by this method 97 times, with but three instances of important hæmorrhage, in one of which the posterior wall of the trachea was cut.

**Thyrotomy.**—Thyrotomy consists in dividing the thyroid cartilage partially or completely in the median line (Fig. 1273, *II*), together with division of the thyro-hyoid and crico-thyroid membranes when additional room is desired. Thyrotomy is performed for the relief of laryngeal obstruction dependent upon various causes, when not amenable to proper aid by simpler means.

*The Operation.*—Place the patient as for laryngotomy, and after proper anæsthesia make in *complete thyrotomy* an incision through the skin *exactly* in the median line from the lower border of the hyoid bone to the upper border of the cricoid cartilage, extending it later as circumstances require; divide in the median line the fascia and contiguous soft tissues down to the cartilage, carefully avoiding the crico-thyroid vessels; draw to either side the borders of the divided soft parts, exposing the thyroid cartilage and the upper portion of the crico-thyroid membrane; incise the crico-thyroid membrane transversely at the lower border of the thyroid cartilage for a short distance, avoiding the crico-thyroid artery below and the cricoid muscles at either side; insert the point of a sharp knife beneath the lower border of the thyroid cartilage exactly in the median line and cut upward sufficiently for the purpose of the operation, leaving, if possible, the upper border of the cartilage unsevered; divide the upper border, if need be, from within outward on a director with a blunt-pointed knife; draw apart the respective borders of the cartilage, detaching sufficiently the crico-thyroid and thyro-hyoid membranes from the cartilage on either side of the larynx to permit of a full view of the laryngeal cavity, after which the special features of the operation are carried into effect.

*The Precautions.*—Divide to no greater extent than necessary the cartilage, for, if complete division be practiced, it is difficult to so adjust the parts as to prevent thereafter functional disturbances of the voice. It is advised that the cartilages be notched in front, also that the sutures be passed through the borders of the cartilages before complete division so that a more accurate union of them may be afterward secured. Since closure of the rima glottidis may result from the swelling following thyrotomy and other operative manipulations, a tracheotomy tube should be passed into the trachea through the lower limit of the wound and retained as long as required, unless a tube is already present below.

*The Remarks.*—A low tracheotomy should be performed before the larynx is opened, when the nature of the trouble bespeaks free hæmorrhage, in which case tamponing may be practiced. Some operators place the patient in Trendelenburg's position, thus obviating the need of the tampon. If the cartilage is calcified, bone-cutting forceps or strong scissors may be required to make the separation.

*The General Comments.*—If the tube be too large, too loose, or too angular, it is liable to cause erosions and ulcerations of the trachea, which may extend through it and implicate the vessels at the root of the neck, causing fatal hæmorrhage. The method of opening into the trachea by a single incision is fraught with danger, and should not be attempted except the neck of the patient be long and thin, and not even then unless the exigencies of the case call for it. The division of the tissues down to the trachea by means of thermo-cautery or galvano-cautery has many advocates; it is not, however, a commendable practice, except, perhaps, in local infections. The searing of the tissues may prevent or lessen hæmorrhage, and likewise obviate the occurrence of infection. This is not altogether true, since the large veins which might be otherwise avoided are burned asunder and too

often cause severe hæmorrhage, which is not easily controlled because of the difficulty of properly securing the charred extremities of the vessels. The resulting cicatrix is more disfiguring than that following other methods. It is advised in bronchotomy for diphtheria and acute affections of the air passages that the tube be dispensed with, since it can only prove a source of local irritation, and obstructs the exit of false membranes and the secretions. As a substitute, the borders of the tracheal opening can be kept drawn asunder by passing looped ligatures through them (Martin), which are united to each other behind the neck with this appliance. The patient must be carefully watched, since if the head be turned the opening may become closed. If this arrangement prove troublesome, an elliptical piece can be removed from the anterior surface of the trachea. If the piece to be removed exceed a third of the diameter of the tube, the high operation, above the isthmus, would be the one more easily and quickly performed, and would as well be less dangerous, as the vessels in that situation are more superficial, smaller, and of less significance. Cutaneous emphysema, bronchopneumonia, and pus infiltration of the thorax are more liable to happen in the low than in the high operation. It is wise to confine the hands and arms of the patient with a body bandage before operation. The median line of the neck should always point toward the center of the episternal notch during operation. The trachea should be seized with a hook and held as steady as possible during its incision and the introduction of the tube. The hissing entrance of air, coughing, etc., indicate that the lumen of the trachea is entered. The use of a probe-pointed bistoury in the enlargement of the tracheal wound affords better protection than the sharp-pointed to the posterior wall of the trachea. Low tracheotomy is indicated when it is desirable to remove the opening as far as possible from the seat of local infection above, also from the seat of hæmorrhage in order that the entrance to the trachea of blood may be more surely prevented. Large growths above call for low tracheotomy. In fact, the site of the opening is controlled by the demands of the case. Careful scrutiny during the operation of low tracheotomy should be exercised to observe and avoid the innominate, carotid, and median arteries, also the active thymus gland in children. As silver tubes sometimes cause the characteristic poisoning of that metal, it is better to use those made of other substances. The introduction of tubes wrapped in tightly fitting iodoform gauze, and their retention for two days, is sometimes practiced for antiseptic purposes. If the tube fits too tightly erosion of the cartilage follows. This sequel is oftener seen in children because of the too limited space in laryngotomy without division of the cricoid cartilage. A tube can be introduced more readily and safely if the head be raised up during the act. The employment of traction loops carried behind the neck and tied together, or connected with a small rubber band for securer action, should be discreetly practiced to avoid the constriction incident to swollen tissues and the tension arising from injudicious tying and persistent rubber traction. Severe and fatal hæmorrhage is sometimes a part of the history of the long-continued use of a badly fitting tube, especially in cases of low tracheotomy. The presence of granulations at the anterior and posterior

parts of the tracheal wound often render the incautious removal of the instrument painful and dangerous because of their obstruction to the entrance of air.

*The After-treatment.*—The tube should be kept in place until the cause for the operation is removed, after which the sooner it is dispensed with the better. However, the final removal should be approached in easy stages so regulated as not to expose the patient to the dangers and discomforts of obstructive symptoms that are so often a part of the history of a case, especially one of a prolonged or paralytic nature, in withdrawal of the tube. Cleanliness of the wound, absence of dust, and the utilization of moistened and medicated air, etc., are the essential features of treatment. The assurance that the tube is open and securely fixed in the trachea during the danger period requires constant attention, especially in children, who by restlessness or non-restraint may displace or remove it.

*The Results.*—But few perish from the direct results of the preceding operations. Bronchitis, infection pneumonia, hæmorrhage from ulceration through the trachea caused by the tube, and primary hæmorrhage from wounds of the vessels at the root of the neck, or from an abnormally large crico-thyroid artery, constitute the leading causes of death directly due to the operation. A deeply cyanosed patient, in the tonic stage of anæsthesia, may die, especially if blood be allowed to enter the tracheal opening. In this contingency the blood must be removed at once, and artificial respiration be resorted to. Tracheotomy in diphtheria is undoubtedly a most feasible operation, and should be performed early, before cyanosis is well established. *Monti*, of Vienna, in his recent work on Croup and Diphtheria, records 12,736 tracheotomies for diphtheria alone, with 3,409 recoveries, or nearly 28 per cent. It is estimated that 25 per cent of these cases have been saved which otherwise would have died. About 27.5 per cent perish from bronchotomy for the removal of foreign bodies. The use of antitoxine and the employment of intubation have rendered in this country the operation of tracheotomy comparatively infrequent. The beneficence of this change in both sentimental and medical aspects is of pronounced importance. The employment of antitoxine at the proper period, while not always preventing the need of tracheotomy, lessens the fatality when required.

**Subhyoid Pharyngotomy.**—This operation is practiced for the removal of foreign bodies and morbid growths situated high up in the air passage, and for the relief of abscesses at the base of the epiglottis.

*The Operation.*—Place the patient as for laryngotomy; administer an anæsthetic, and make an incision an inch and a half or two inches in length transversely along the lower border of the hyoid bone, with its center in the median line (Fig. 1272, *e*). The integument, fascia, platysma, and the inner portions of the sterno-hyoid muscles, and finally of the thyro-hyoid muscles, are divided on a director. The only vessel contiguous to the incision is the superior thyroid artery, which runs along the upper border of the thyroid cartilage parallel with the incision. The thyro-hyoid membrane is now exposed and opened by a sharp-pointed knife carried obliquely upward. The mucous membrane is divided through the glosso-epiglottic fossa aided

by the fingers introduced into the mouth. If the greater cornua of the hyoid bone be severed about three fourths of an inch from the extremities, access to the pharynx will be facilitated. Divided vessels should be promptly tied to prevent entrance of blood to the trachea. As soon as the thyro-hyoid membrane is cut, the epiglottis will project through the opening, and must be drawn aside, when the tumor will be exposed to view (Fig. 1276). After the removal of the growth, the wound is closed and dressed antiseptically. The majority of the conditions calling for this operation can be satisfactorily treated through the mouth.

*The Prognosis.*—The operation itself implies no unusual danger to the patient.

A preliminary tracheotomy should be performed if undue hæmorrhage is anticipated, as in the extirpation of a vascular growth, supplemented, perhaps, by plugging the trachea in urgent instances. The Trendelenburg posture will afford great advantage.

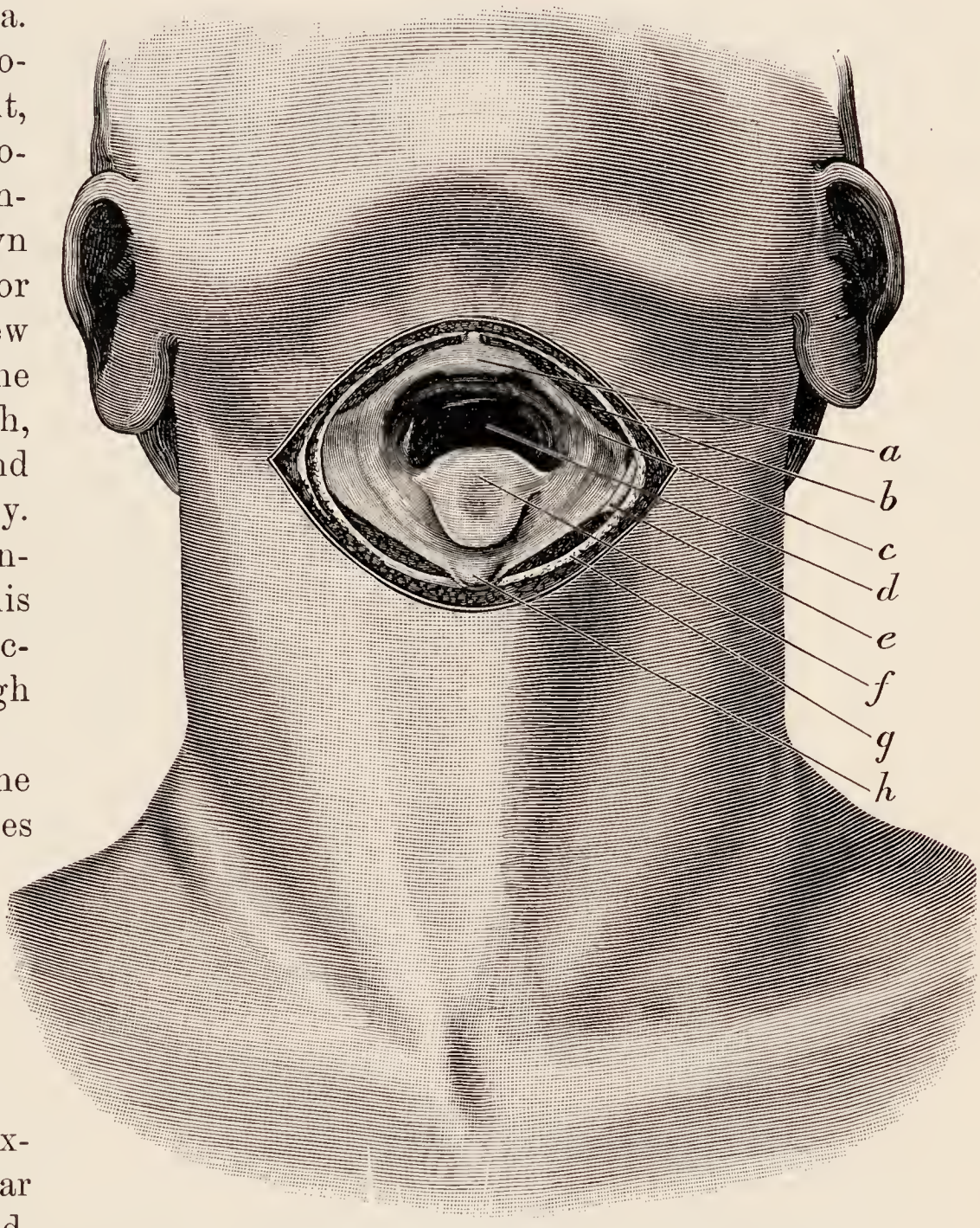



Fig. 1276.—The operation of subhyoid pharyngotomy. *a*. Hyoid bone with thyro-hyoid membrane attached. *b*. Sterno-hyoid and omo-hyoid muscles. *c*. Extremity of greater cornu. *d*. Entrance to larynx. *e*. Superior laryngeal nerve. *f*. Epiglottis. *g*. Platysma. *h*. Thyroid notch.

**Intubation of the Larynx.**—*Bouchut*, of Paris, conceived the idea, and O'Dwyer, of New York, by indefatigable and patient labor achieved the imperishable distinction of establishing its utility upon an enduring basis. Foreign bodies in the larynx and diseased processes contiguous to it, causing obstructive dyspnœa, are, as a rule, better treated by tracheotomy than by intubation. Chronic stenosis of the larynx from tubercle, syphilis, and other chronic states of an inflammatory nature can be promptly and often effectually treated by intubation. However, the chief importance of the measure rests in affording prompt relief in impending suffocation from membranous obstruction (Fig. 1277). The following is a description of the apparatus:

"The numbers on the scale (Fig. 1277, *e*) indicate the years for which the corresponding tubes are suitable. For instance, the smallest tube when applied to the scale will reach to the first line, marked 1, and is intended to

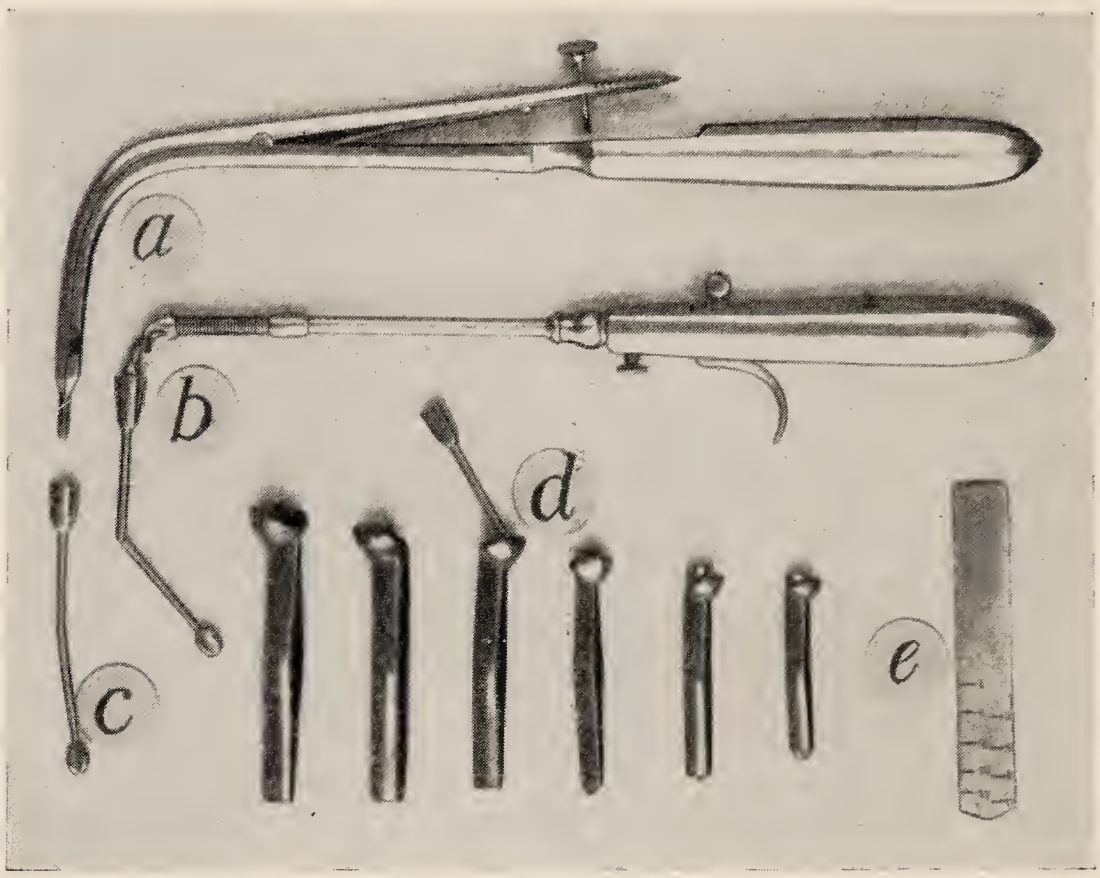



FIG. 1277.—The O'Dwyer apparatus for intubation.

*a*. Extractor. *b*. Introductor with obturator attached. *c*. Obturator detached. *d*. Tubes, assorted sizes, one with obturator in place. *e*. Scale indicating size of tube mouth gag (Figs. 4 and 1278), also the O'Dwyer gag. Tongue depressor may be required.

be used up to the age of twelve or fifteen months; the size marked 2 is suitable for the next year, 3 and 4 for these years, and so on. When the proper tube is selected for the case to be operated on, a loop of fine thread about fourteen inches in length is fixed through the small hole near its anterior angle, and left long enough to hang out of the mouth after the introduction of the tube, its object being to withdraw the tube should it be found to have passed into the œsophagus instead of the larynx.

"The obturator (Fig. 1277, *c*) is then fastened tightly to the introductor (Fig. 1277, *b*), to prevent the possibility of its rotating while being inserted, and passed into the tube.

"The following is the *method of introducing the tube*, which is done without the use of an anæsthetic: The child, with the arms confined, is held upright in the arms of a nurse, and the gag is (Fig. 1278) inserted in the left angle of the mouth, well back between the teeth, and widely opened; an assistant holds the head, thrown somewhat backward, while the operator, standing in front, inserts the index finger of the left hand backward and downward into the throat, elevates the epiglottis, draws the base of the tongue forward, and at the same time directs the tube into the larynx (Fig. 1279).

"The handle of the introductor (Fig. 1277, *b*) is held close to the patient's chest in the beginning of the operation, and rapidly elevated so that the tube approaches the glottis at an acute angle, and passing under the end of the

finger (Fig. 1280) is then pushed downward in the median line, without using force, and pressed into place by the finger and the tube detached (Fig. 1281). The joint in the shank of the obturator is for the purpose of facilitating this part of the operation. As soon as the obturator is removed, and it is ascertained that the tube is in the larynx, the thread is withdrawn, but at the same time the finger is kept in contact with the tube to prevent its being also withdrawn (Fig. 1282).

"It is important that the attempt at introduction be made quickly, as respiration is practically suspended from the time that the finger enters the larynx until the obturator is removed. It is therefore, under the circumstances, much safer to make several abortive attempts than one prolonged effort, even if successful.

"For the purpose of removal, the patient



FIG. 1278.—The operation of intubation, method of introducing the tube. The respiratory tract of operator protected from infection by mouth shield, and clothing by a gown.

is held in a similar position, except that the head is not inclined backward, or very slightly so, and the extractor (Fig. 1277, *a*) is passed cautiously and lightly into the tube guided by the index finger of the left hand, which also fixes the epiglottis, and is brought in contact with the head of the tube. Firm pressure with the thumb is then made on the lever, above the handle, while the tube is being withdrawn. If secondary dyspnœa supervenes at any time, the tube should be removed and a larger one substituted."

The late Dr. O'Dwyer recommended that preliminary practice in the introduction and removal of the tube, and touching of the parts, be had upon the cadaver when possible. The removal of the tube is more difficult than the introduction, on account of the trouble of inserting the blades of the extractor into the open upper end of the tube while more or less completely hidden from view by the natural position of the surrounding soft parts. This part of the operation becomes especially troublesome when the patient offers any opposition to the attempt, and it may become necessary under these circumstances to administer an anæsthetic before the tube can be safely removed. The occurrence of spasm during this time may be met by holding the finger in place until the irritation subsides.

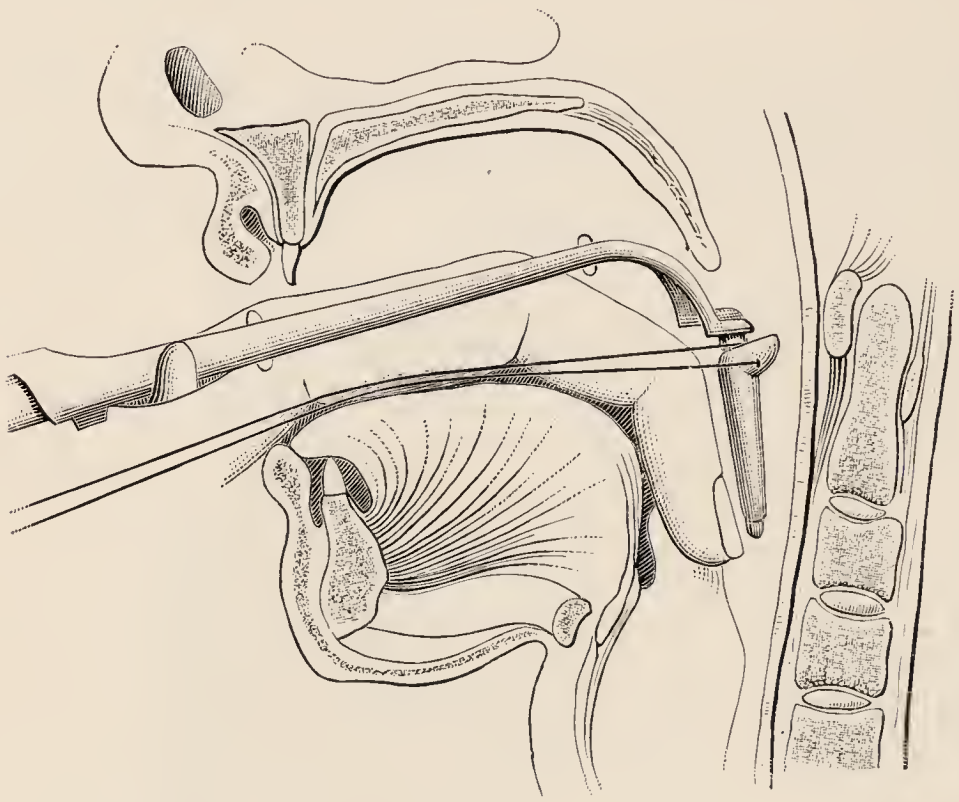


Fig. 1279.—The operation of intubation. Elevating epiglottis and drawing tongue forward with finger, directing tube into larynx. String in tube.

*The Precautions.*—It is often wise in intubation to prepare for tracheotomy (Fig. 1270), as efforts at intubation may not succeed. Do not remove the loop until quiet breathing has continued for half an hour or so, and do not permit the patient to grasp it. The introduction of the tube is rarely attended with asphyxia due to detachment downward of the membrane, and then, if the patient be caused to cough as the tube is quickly withdrawn, the membrane is usually expelled. Failing in this, tracheotomy forceps may be tried for removal of the membrane which, if ineffective, is followed at once by tracheotomy. Three or four per cent only require the latter measure of relief. The tube may be passed into the œsophagus and possibly enter the trachea. The evidences of par-

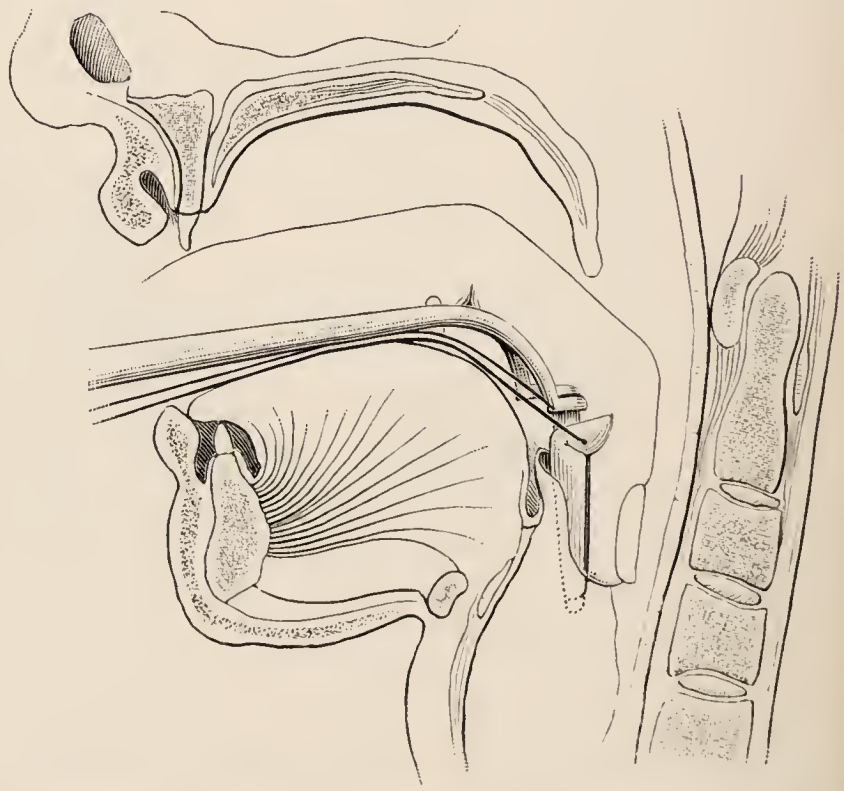


Fig. 1280.—The operation of intubation. Tube passing under end of finger.

tially detached membrane in the trachea call for prompt removal of the tube. Inversion of the patient and striking of the body by the attendants may cause the tube to be expelled along with the obstructing membrane and rescue the patient without the dangers of delay. The not infrequent occurrence of severe and perhaps fatal dyspnœa, following removal of the tube, enjoins close attention to the patient for an hour or so thereafter.

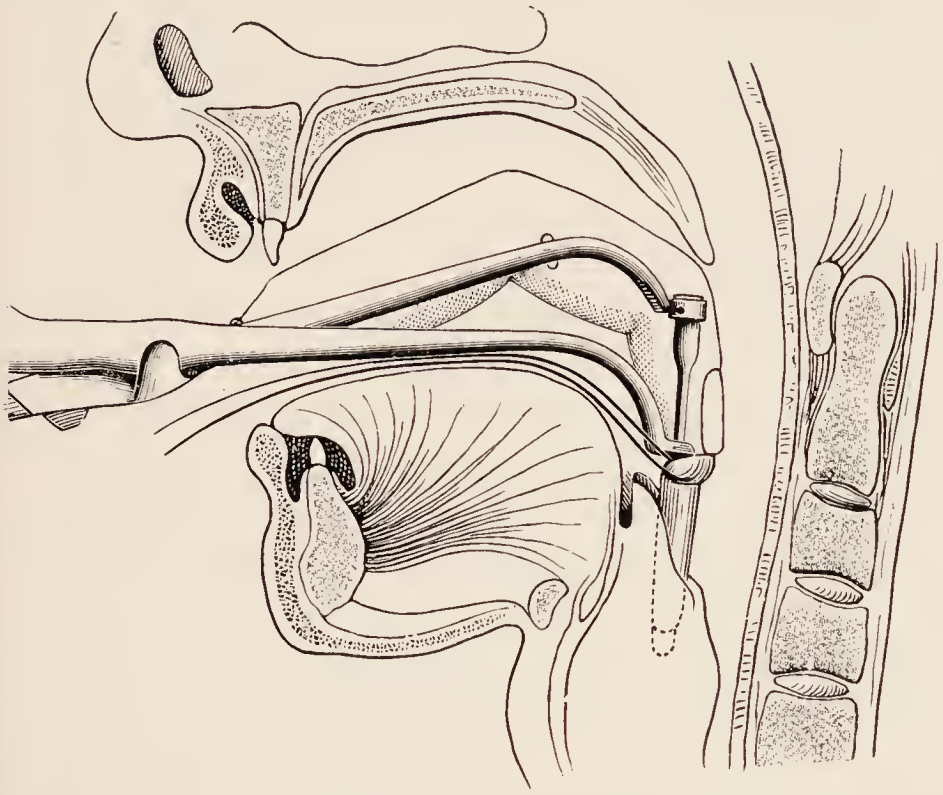


Fig. 1281.—The operation of intubation. The tube pressed into place with the finger and detached from obturator.

*The Remarks.*—In the adult the tube can be introduced by aid of a mirror, especially when the throat is accustomed to the use. It is wise for the operator to give some little amount of time to practicing in introducing the tube. The extracting of the tube from the clinched hand will offer in a degree the needed opportunity for this kind of practice. Should the tube happen to slip below the vocal cords it will no doubt be arrested by the cricoid cartilage and only by division of the latter can the tube be withdrawn from below.

*The After-treatment.*—Quiet, support, and cleanliness are indicated. *Carey* and *Casselberry* have recorded the important fact that with the head lower than the shoulders food can be swallowed quite readily with the tube in place without much trouble. Highly nutritious fluid foods are commonly employed in these cases. Usually the tube is removed in four or five days and not reintroduced thereafter without special indications.

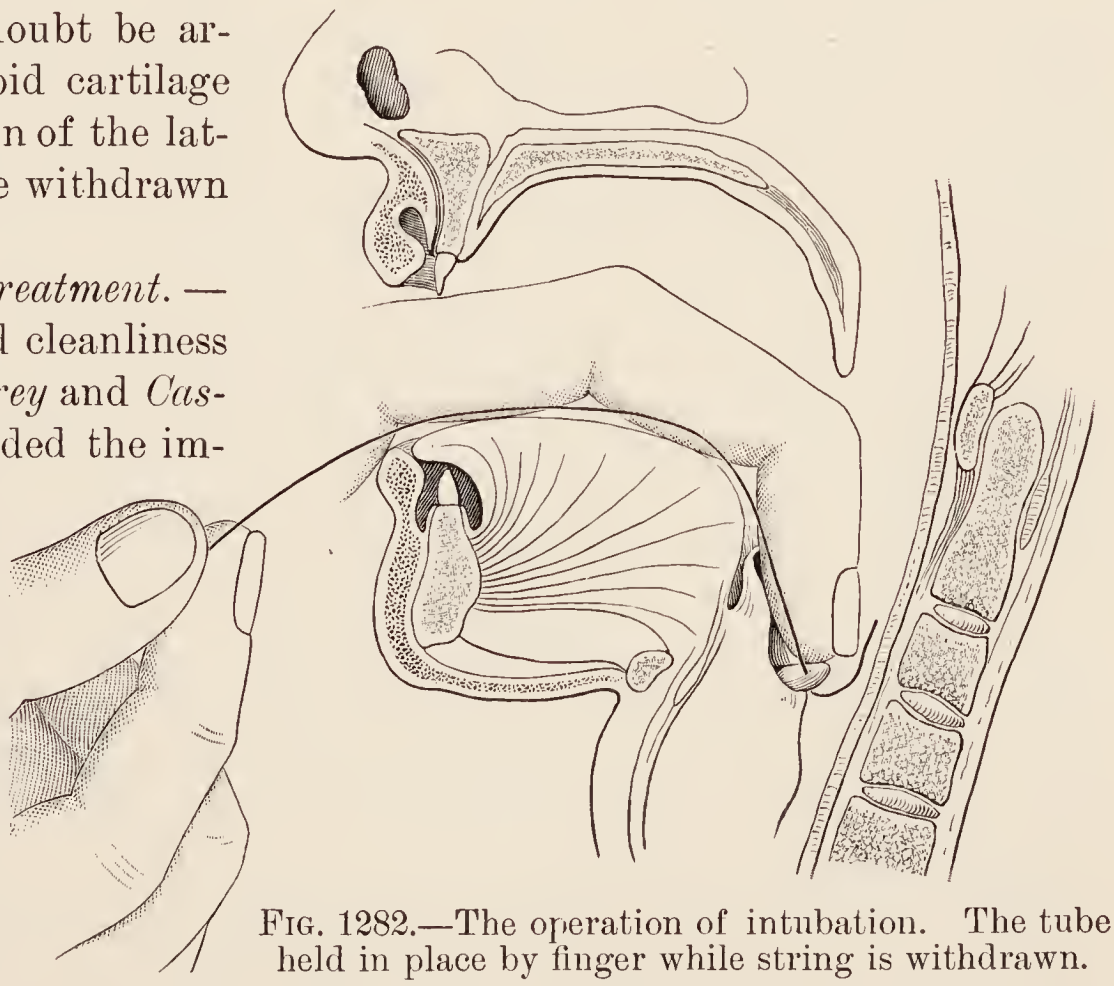


Fig. 1282.—The operation of intubation. The tube held in place by finger while string is withdrawn.

*The Results.—McNaughton* and *Maddern* reported 5,546 cases of intubation with 69.5 per cent mortality without the use of antitoxine. Five hundred and thirty-three cases with the use of antitoxine gave 25.9 per cent mortality. With the use of antitoxine—

| | Cases. | Recoveries. |
|---|---|---|
| Brown reports | 2,368 | 647 |
| Ranke reports | 1,445 | 553 |
| McNaughton reports | 72 | 28 |
| O'Dwyer reports | 30 | 10 |

*Waxham* reports 543 cases of intubation in private practice with 39.29 per cent recoveries.

It is quite apparent that intubation is followed by a higher rate of recovery than is tracheotomy, and that the administration of antitoxine increases the efficiency of intubation in an astonishing degree.

**Foreign Bodies in the Air Passages.**—Foreign bodies invade the air passages, and in many instances cause alarming symptoms followed by a rapid and fatal outcome. The larynx, trachea, and bronchi are the common sites of invasion, and demand the exercise of discreet though prompt and efficient action for relief. A knowledge of the nature of the foreign body is of great importance, as bearing on the ease of removal and the kind of tissue changes induced by its presence. The surroundings of the patient have much to do with determining the nature of these bodies. However, corn, beans, various seeds, and small toys make up a large proportion of these offending agents. Seeds increase in size naturally from the absorption of moisture, and become therefore more difficult of removal as time advances. Organic agents of infective character are especially dangerous because of the tissue changes which they incite. Inorganic substances are the least objectionable unless endowed with some special destructive nature. The employment of the X rays are especially serviceable in determining the location and nature of the object.

*The invasion of the larynx* by a foreign body, attended with symptoms of pronounced character, calls for a prompt examination of the throat and larynx with the finger, and unless relief be thus promptly afforded, laryngotomy in the adult and tracheotomy in the child should be performed at once. When the symptoms are not urgent, a more deliberate course can be followed, fortified by the knowledge gained by the use of the laryngoscope, fluoroscope, and other methods of inquiry. And, too, the removal may be deliberately conducted with approved instruments, and operative procedures directed to opening the larynx above, through, or below the thyroid cartilage, according to the situation of the foreign body, utilizing by this route the best channel for removal.

*The invasion of the trachea* by a foreign body calls for a prompt low tracheotomy, which should be done, if possible, before the fixation of the foreign body in a bronchus takes place. The opening should be free to admit of prompt escape of the offending agent with the act of coughing. If the foreign body have become fixed already, dislodgment should be at-

tempted with a probe or feather, while the tracheal opening is held widely apart to facilitate the escape. Inversion of the patient, thumping on the back, etc., are practiced *after tracheotomy* is performed. In the interval of the attempts at removal the borders of the tracheal wound should be held widely apart with traction sutures carried through each border around the neck and tied behind.

*The invasion of a bronchus* by, and final fixation there, of a foreign body, while not immediately dangerous, exposes the patient to many problematical contingencies of a fatal nature. The foreign body may block the entire right or left bronchus, or one or more subdivisions of the same, singly or simultaneously, according to its size. The right bronchus is involved more frequently than the left, the proportion being three of the former to two of the latter.

*The Treatment.*—In the instance of seed impaction, a policy of conservatism is usually the wiser one.

*Inversion and thumping* on the back can be practiced without tracheotomy when the object is known to be of so small a size as to readily escape through the rima glottidis. However, if the object be a large one or of uncertain size, or the case one which has been attended already by violent efforts at expulsion, then tracheotomy and wide separation of the tracheal opening should always precede any effort at dislodgment.

*Direct dislodgment* is practiced with forceps, probes, bent wire, blunt hooks, suction by a rubber tube attached to Bigelow's litholopaxy pump, corkscrew apparatus, etc. The stereotyped and extemporized implements and means for extraction are numerous, but favorable outcome does not keep pace with ingenuous though often unwise instrumentation. In general terms the following plan of interference is commended: Locate the site of the impacted obstruction by auscultation, etc.; perform a free, low tracheotomy, and hold the borders of the tracheal wound widely asunder with traction sutures; introduce a flexible probe, and locate the obstruction and dislodge it if possible; failing in this, try forceps of proper size and shape, or a wire with a hooked extremity, or fine silver wire looped and passed beyond the obstructing agent and withdrawn. The patient should be under an anæsthetic during the attempts, otherwise the spasmodic cough, due to the irritation of the manipulation, will defeat careful effort and perhaps cause avoidable disaster. It may be advisable to open the thorax posteriorly to effect relief (page 1046).

*The Comments.*—When tracheotomy is followed by entire relief from dyspnœa, the foreign body is either in the larynx or occupies a small tube. The presence of a foreign body in the bronchus is not an absolute indication for operation, as circumstances may contraindicate it. When the obstruction can be located, a low tracheotomy is justifiable with brief, cautious attempts at extraction.

The question of tracheotomy will depend largely upon the form, size, and character of the foreign body. Not more than three attempts of a minute each should be employed with forceps to remove a foreign body (Gross).

"Low tracheotomy is advisable when the presence of a foreign body is certain; it adds but little to the risk and affords easier escape for the object, even when extraction is not feasible.

"Subsequent dangers arise from severe and prolonged instrumentation, not from tracheotomy. Voluntary expulsion is more probable after than before tracheotomy.

"The risks of thoracotomy and bronchotomy, following unsuccessful tracheotomy, are greater than the dangers incurred by permitting the foreign body to remain" (Willard).

*The Results.—Voluntary expulsion* is not an uncommon occurrence, happening within a few hours, or after weeks' and even years' delay. Nearly 90 per cent will recover without operative interference (Weist).

"When a foreign body becomes impacted in the bronchus, extraction is an impossibility in 78 per cent of the cases even after tracheotomy" (Willard).

The employment of instruments increases the death rate from pneumonia 12 per cent. *Smith* reports in 1,600 cases a 70-per-cent rate of recovery in the non-operative and 76 per cent in operative cases. *Dunham* reports 50 per cent recoveries in non-operative and 77 per cent in operative cases.

*Guyon* and *Dunham* in 1,674 cases report 70 per cent recoveries in non-operative and 75 per cent in operative cases. About 10 per cent die from the operation only.

**Laryngectomy.**—Laryngectomy is a serious operation and is not practiced except for the cure of malignant disease. It consists in the removal of a part or the whole of the larynx, and is classified, therefore, as the complete and incomplete varieties.

**Complete Laryngectomy.**—If the neck be not too short for the purpose, as may be the case in emphysematous patients, a preliminary tracheotomy should be performed several days in advance of the major operation, to accustom the pulmonary tissues of the patient the sooner to the influences of the abnormal respiratory channel. If the neck be too short for the utilization of this preparatory step, the cannula may be introduced during the course of the operation (Kocher). After the patient is anæsthetized, the trachea should be plugged by the use of the Trendelenburg or the Hahn sponge tampon cannula (Figs. 1284 and 1285), being certain that the rubber tampon is new and that it be slowly distended into the proper position. The ordinary cannula, supplemented by sponge packing, is employed with entire satisfaction by many surgeons.

*The Operation* (Kocher).—Place the patient on the back with the shoulders raised and the head extended over a padded bottle or sandbag; make an incision in the median line from the hyoid bone downward to a point an inch and a quarter below the cricoid cartilage, exposing the thyroid and cricoid cartilages and the upper border of the isthmus of the thyroid body; divide the suspensory ligament of the isthmus at the lower border of the cricoid; separate the isthmus and its associated transverse veins from the trachea and push them downward with a blunt dissector; divide the cricoid

and upper rings of the trachea in the median line, forcing the isthmus downward and even dividing it between two ligatures in the median line if sufficient room can not be otherwise gained; introduce the tampon cannula; make a transverse incision through the skin and fascia along the hyoid bone, ligaturing the anterior jugular veins; divide the sterno-hyoid, the omo-hyoid, and thyro-hyoid muscles close to the hyoid bone, at their insertions; draw the hyoid bone up with a strong, sharp hook; divide transversely the portion of the thyro-hyoid membrane attached to the middle part of the hyoid bone; divide also the subjacent mucous membrane and seize the epiglottis at its upper part with a sharp hook and draw it forward; slit the epiglottis medianly if healthy, if unhealthy cut round it beyond the diseased tissue; split the thyroid cartilage at the middle downward to the tracheal wound; arrest hæmorrhage at the wound edges and paint them with a ten-per-cent solution of cocain to obviate the coughing and swallowing reflexes; define the limits of the new growth and divide the tissues beyond them; divide the mucous membrane with the thermo-cautery. If the whole larynx be diseased, divide the mucous membrane along the epiglottis, arytenoid cartilages, the larynx or trachea, to below the tumor; expose the outer surface of the larynx, preserving the muscles in so far as is consistent with the removal of diseased tissue; expose the cartilages and remove them partially or entirely, according to the extent of the disease; retain the healthy and movable mucous membranes at the posterior surface of the cricoid cartilage; continue downward the dissection to the lower limit of the disease, dividing the healthy cricoid or trachea transversely; sew upward as far as possible the anterior wall of the œsophagus and pharynx to re-establish the septum between the respiratory and alimentary passages.

*The After-treatment.*—Substitute a simple cannula for the tampon cannula. Introduce no sutures, but stuff the cavity with carbolic gauze which is changed every two hours. Feed the patient through an œsophageal tube and get him out of bed as soon as possible.

*The Results.*—But 1 case in 12 died from this plan of operation.

**Treves's Method.**—The following succinct plan of procedure is introduced from Treves's Operative Surgery:

"*The Operation.*—The patient lies upon the back, close to the right border of the table. The shoulders are raised, and the head is well extended over a hard cushion or sandbag. The surgeon stands on the patient's right. The chief assistant takes his place at the head of the couch, and close to the surgeon's left. An incision is made in the median line from the center of the thyro-hyoid membrane to the second or third ring of the trachea. At the upper end of this incision a transverse cut is made which is carried outward on either side sufficiently far to reach the sterno-mastoid muscles.

"The flaps thus marked out are turned back. Some division of the fibers of the sterno-mastoid muscles may be necessary. The vertical incision should go down to the thyroid and cricoid cartilages and the trachea.

"The superior thyroid arteries may, if thought fit, be dealt with at this stage. They should be secured by two ligatures, and then divided between

them. The vessels would be sought for at the posterior margin of the thyro-hyoid muscle, close to the upper border of the thyroid cartilage.

"The inferior thyroid arteries may be exposed and dealt with in the same manner as they turn forward at the lower margin of the larynx. They should be sought for beneath the posterior edge of the sterno-thyroid muscle.

"The fascia having been well divided in the middle line, a broad periosteal elevator or a rugine is introduced, and by means of it the soft parts can be separated from the laryngeal cartilages without employing the knife.

"The crico-thyroid, sterno-thyroid, and thyro-hyoid muscles are detached on one side, and are, together with the other soft parts, held with a retractor while the larynx is drawn over to the other side by means of a sharp double hook. The attachment of the inferior constrictor muscle to the thyroid cartilage can now be severed, partly by detachment with the elevator or rugine, and partly by cutting it with curved, blunt-pointed scissors, which are kept very close to the cartilage. The larynx is now pulled forward as well as to the opposite side, and the tissues are divided about the gap which intervenes between the cut and now separated ends of the superior thyroid artery. The superior laryngeal nerve is also now divided. The thyroid gland is pushed aside with the soft parts.

"If the larynx be now well drawn over to the other side, the other half of the organ can be stripped of its coverings in precisely the same manner.

"The next step is to divide the thyro-hyoid ligaments and membrane, and to cut the extralaryngeal connections of the epiglottis. This structure may be conveniently drawn forward while its attachments are being freed.

"The entire larynx is now pulled forward by means of sharp hooks introduced into its upper part, and the organ is separated from its remaining connections with the pharynx and œsophagus—at first laterally, and then from above downward.

"If proper care be taken, the œsophagus should be nowhere 'button-holed.' Special care is required to separate the cricoid cartilage from the commencement of the gullet.

"The trachea is now secured (unless already adherent) by means of two ligatures, which are held by an assistant, and the excision is completed by dividing the membrane between the cricoid cartilage and the trachea from behind forward.

"One or more rings of the trachea may be removed at the same time if it be considered necessary.

"The upper end of the divided trachea, which has been prevented from slipping down by the two ligatures, is now secured to the integument by several points of interrupted suture.

"Three or four deep sutures of silver wire are passed beneath the uppermost ring, and are made to attach the windpipe securely to the skin; a further series of fine superficial sutures unite the mucous membrane of the trachea to the cut margin of the skin.

"The bleeding throughout the operation will be free, and each small vessel should be ligatured as soon as it is divided. The limited space does not favor the use of many pressure forceps."

*It often happens* that in addition to the larynx the hyoid bone, base of the tongue, pharynx, and œsophagus are involved in a malignant growth. If operation be attempted, under these circumstances, the first step is to introduce the tampon cannula of Trendelenburg, or a substitute, through which the anæsthetic is administered. Then make a transverse incision through the skin from the inner edge of one sterno-mastoid muscle to the other, passing half an inch above the hyoid bone; from this carry a second one vertically downward along the median line of the trachea to the incision made to open the trachea; turn the flaps outward; remove all large glands in the vicinity; divide the muscular attachments to the hyoid bone; tie the lingual and superior thyroid arteries; excise the tongue below the disease, along with the palato-pharyngeal arches, if necessary, carefully avoiding the external carotid arteries when it is possible; if not possible, draw them forward along with the pharynx and divide them between two ligatures; cut the lingual and hypoglossal nerves. The larynx is now separated from the trachea by cutting the latter just below the cricoid cartilage; a cannula is introduced into it, the parts are thoroughly washed with a carbolized solution, the flaps placed in contact with the raw surfaces without sutures, and the wound sprinkled with iodoform. If the œsophagus be divided, its lower extremity must be kept open and so placed that it can be protected from the entrance of discharges, and become an available channel through which to nourish the patient.

**Partial Laryngectomy.**—Partial laryngectomy is practiced when the limited extent of the disease does not require the removal of the entire organ. Half of the larynx, or half of the thyroid cartilage, with or without the cricoid, may be removed. Inasmuch as the same dangers are incurred as in the complete operation, although in a lesser degree in some respects, similar means of prevention are necessarily employed. The incisions relate only to the affected side. The organ is split in the median line and the cavity examined. The thyroid cartilage is carefully removed (page 1078), cautiously avoiding injury of the pharynx. The associated membranes are divided as closely as practicable to the cartilage. The superior cornu of the cartilage is removed with strong scissors or pliers. The epiglottis is usually left entire, and the aryteno-epiglottidean fold of the diseased side is divided close to the cuneiform cartilage.

*The Precautions.*—Prompt arrest of hæmorrhage, close hugging of the cartilage during removal, careful avoidance of injury to the œsophagus, complete asepsis, and the prevention of pulmonary infection are the important features of the operation.

*The Remarks.*—The tampon cannula and the tracheotomy tube are subject to the same use as in the complete operation, except that they are employed for a briefer period. The cricoid cartilage may be removed entire, or half only may be taken away along with the thyroid. The fact that cancer slowly involves the cartilage, causing localized death, unattended by much infiltration, suggests the practice of removal of circumscribed disease by cutting and scraping, even when the cartilage is superficially involved. We are not disposed to regard with favor treatments of this kind, unless for some

special reason, and then only when a strict monthly surveillance can be exercised to note any evidences of return. The after-treatment is not unlike that of the complete operation, but is less extended because of the less profound nature of the wound.

*The Results.*—The death rate of partial removal is lower than is that of complete removal. The rate of final cure is somewhat less in the former than in the latter method of practice.

*The General Remarks.*—An ordinary tracheotomy tube can be fortified with a sponge confined in place around the tube with thread, so that when wet it will occlude the trachea. *Gussenbauer* regards high tracheotomy as a legitimate part of the procedure and performs it as an initial step. Splitting of the larynx enables one to determine the extent of the disease, and perhaps save a part of the organ. There appears to be no good reason why the epiglottis and cricoid cartilage should be saved even though not diseased and their presence is sometimes objectionable. Enlarged cervical glands should be sought for and removed. Malignant involvement of the soft parts outside the larynx contraindicates operation. Only the transverse skin incisions are sewed. The wound is stuffed with gauze, which is changed every eight hours or so. The tampon cannula is usually removed and the tracheotomy tube substituted after two or three days. However, some surgeons employ the former much longer—ten or twelve days. *Treves* advises that a rubber tube be introduced into the stomach through the œsophagus, and fastened there for four or five days, and even longer, for alimentary purposes. In 171 cases preliminary tracheotomy was omitted in but 8. The tissues should not be bruised or torn during their separation from the larynx, but instead should be clean cut. Therefore, suitable room for observation and treatment should be secured by judicious division of restraining tissues. Complete arrest of bleeding is necessary before opening the air passages, especially if preliminary tracheotomy has not been done. Additional caution is requisite to prevent wound infection when the larynx has been split before removal.

**Keen's Plan of Operation.**—*Keen*, in a recent address * on the technique of total laryngectomy, in reporting a strikingly successful case of his own, dwelt especially on the preparatory and technical steps of the operation. He advises that thorough preliminary disinfection of the mouth, nasopharynx, and larynx with suitable antiseptic solutions be frequently made for two or three days before the operation. Thorough and frequent use of the toothbrush and the removal of offending carious stumps are also advised. The performance of tracheotomy ten days or two weeks before operation is counseled in cases suffering from dyspnœa, and then only for improving the patient's condition and not to prevent the entrance of blood to the trachea. Tracheotomy immediately preceding or attending the operation, Keen does not regard as essential in all cases, and when thus practiced the opening should be closed, if practicable, as soon as the operation is completed. He substitutes when advisable the Trendelenburg position for the

* Transactions of the American Surgical Association, vol. xvii, 1899.

use of the various tampon cannulæ, thus removing from the list an agent of hindrance and of special danger. Anæsthetics are administered through the mouth until the air passage is opened, when a large tracheotomy tube is introduced, through which anæsthesia is continued. The patient's head is kept low for a day following the operation by raising the foot of the bed. On the second day the horizontal, on the third day the sitting posture, and on the fourth out-of-bed, respectively, is advised. Nutritive enemata are given for two days, followed by a teaspoonful of liquid food every half hour by the mouth, washed down by a tablespoonful of sterile water. At the end of a week the amount is much increased, solid food being taken after the tenth day. In the reported case the patient could swallow from the first without instrumental aid. Also in this case the gauze drain was removed on the following day, half of the stitches on the fourth, and the remainder on the sixth day after the operation. In the case in question the total extirpation followed about four and a half months after a thyrotomy performed for cure of an intralaryngeal malignant growth. The patient was placed in the Trendelenburg position and a median incision was made along the scar of the previous operation. The thyroid cartilage was split in halves, the borders were drawn apart to determine the extent of the disease, and thereby also that of the proposed operation. The soft parts were dissected away from the sides of the larynx, the median incision was carried down nearly to the sternum, the trachea exposed, a low tracheotomy done, an ordinary large tracheotomy tube introduced, the inner tube then removed, and the chloroform apparatus connected with the central tube by means of the metal tube of Hahn's cannula. The trachea was then divided across below the thyroid cartilage, the lower end of the larynx drawn forward and upward by means of a hook and the finger, and the posterior surface of the organ was separated from the œsophagus by means of the finger and Allis's blunt dissector as far as the upper border, when the attachments to this portion were divided with scissors and the larynx was removed. The epiglottis was also removed. "The upper edge of the anterior wall of the pharynx was then carefully attached to the tissues just below the hyoid bone by interrupted silk sutures placed very close together," thus shutting off the secretions of the pharynx and mouth from the wound. The upper end of the trachea was united to the skin by silk sutures, the tube removed, and the tracheotomy wound closed by suturing the rings with catgut, and the remaining tissues of the wound by silkworm-gut sutures. The wound above the exposed end of the trachea was closed by silkworm-gut sutures and a small gauze drain inserted at its lower portion. Narrow strips of folded gauze were laid above and below the exposed end of the trachea, which was then protected by placing over it a sterilized wooden pill box without bottom or top, covered with two or three layers of gauze properly fastened to the contiguous dressing. The pill box and gauze were removed from time to time for the purposes of cleanliness. The wound healed at once throughout and the patient made a prompt, complete, and uneventful recovery.

*The Remarks.*—After four days the occasional introduction of the tube was advisable to counteract the tendency to closure of the open end, because

of contraction, and to the inturning of the integumentary borders. As already indicated at the beginning, the stitches should be removed as promptly as possible. In indicating briefly the future technique in a similar case, Keen says: "In my next case, after dissecting the soft parts from the larynx and upper trachea back to the œsophagus on both sides, I shall place the patient in the Trendelenburg position and deepen the narcosis to a slight extent. I shall then divide the trachea transversely, and by three sutures, one in the middle line and one on each side, shall quickly attach the tracheal stump to the skin. Then I shall introduce the ordinary tracheotomy tube into the open end of the trachea instead of through a tracheotomy wound, and continue the anæsthetic through the tube. The later steps of the operation will be the same as above described. In order not to embarrass the operator the flange of the tracheotomy tube should only project at the sides, as the usual wide upper border of the flange would interfere with access to the parts at the beginning of the removal of the larynx."

The plan of action expressed and practiced by Keen reduces the danger from infection to a minimum and shortens the time of operation. In suitable cases, and in the hands of experienced operators, the arrangement of the details will without doubt greatly improve the outcome in many respects. The amount of hæmorrhage is comparatively small in any event if care be exercised in the selection of cases and in their treatment. The utilization of the artificial larynx is prevented in this method unless a secondary operation be done.

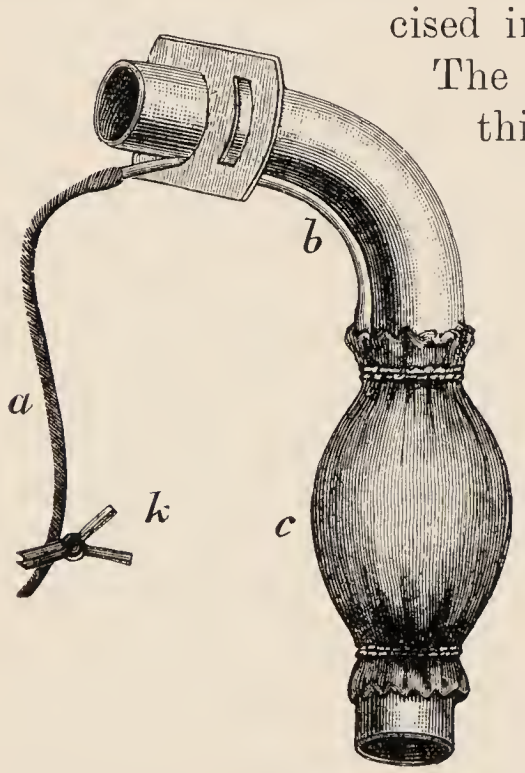



FIG. 1283.—Trendelenburg's tampon. *a*, *b*. Tube for inflating rubber bag (*c*). *k*. Clamp.

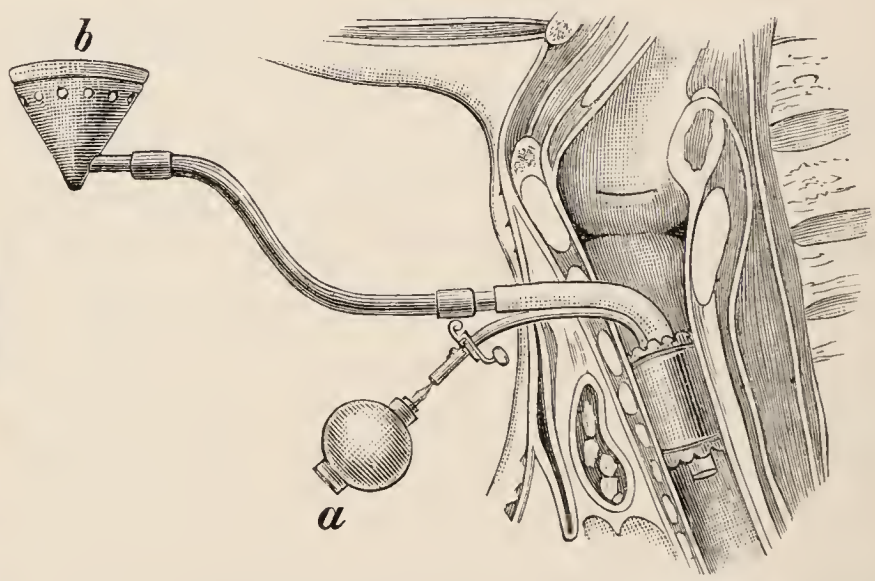



FIG. 1284.—Trendelenburg's tampon in position. *a*. Bag for inflation of the tampon. *b*. Metallic funnel covered with flannel for anæsthesia.

*Perier* recommends the performance of laryngectomy without preliminary tracheotomy through an I-shaped incision made from the hyoid bone to below the cricoid cartilage. The larynx is exposed laterally, two stout threads are passed through the trachea at the site of proposed division, the trachea is severed, and a special tube is inserted into the open end through which anæsthesia is continued while the operation is being completed.

**Tamponing of the Trachea.**—Tamponing the trachea calls for more than passing notice because of the acknowledged, direct, and consequent dangers

which the act incurs, and also of the growing tendency to ignore tampon cannulæ altogether when it is possible to supplement their utility by postural methods. Tamponing the trachea is done to prevent the entrance of blood to the trachea in unusual operations on the larynx, and the oral, and pharyngeal cavities. The methods most often employed are those of Trendelenburg (Figs. 1283 and 1284), Hahn (Fig. 1285), and Gerster (Fig. 1286). *The first* is provided with a thin rubber bag so adjusted to the tube that after introduction into the trachea it can be inflated with air by a rubber bulb. If it is to remain some time after the operation, water or glycerin are regarded as more serviceable than air. *In the second*, medicated sponge is substituted for the rubber bag. The sponge is fashioned of a proper shape and thickness, fastened around the tube with thread, and permitted to dry. The thread is then removed, leaving the sponge firmly fixed in place, which is then covered with rubber tissue tied in position. The extremity of the tampon is introduced and the sponge moistened with a solution of boric acid injected into it through an opening in the tube by a hypodermic syringe. The sponge swells and closes the trachea, and may be permitted to remain in place for some time provided that the discharges of the wound do not come in contact with it. *The third form* is caused to fit the trachea by inflation. The mechanism of its adjustment for use is commendable. However, the objections to the use of these forms of apparatus is fast leading to their abandonment when possible. The rings of the trachea have sustained severe injury from their introduction and from pressure necrosis. The failure to properly close the trachea and the liability of the rubber to rupture have been followed by annoying complications from hæmorrhage. A too great distention may cause the rubber tissue to balloon and obstruct the end of the tube. Gerster's apparatus seems to afford the most satisfaction of any. Each of these cannula is provided for the adjustment of a stereotyped (Fig. 1284) or extemporized (Fig. 747) appliance for the administration of the anæsthetic. The introduction into the open end of a tracheal stump of a large ordinary tracheotomy tube supplemented by gauze packing around it is a prompt and serviceable

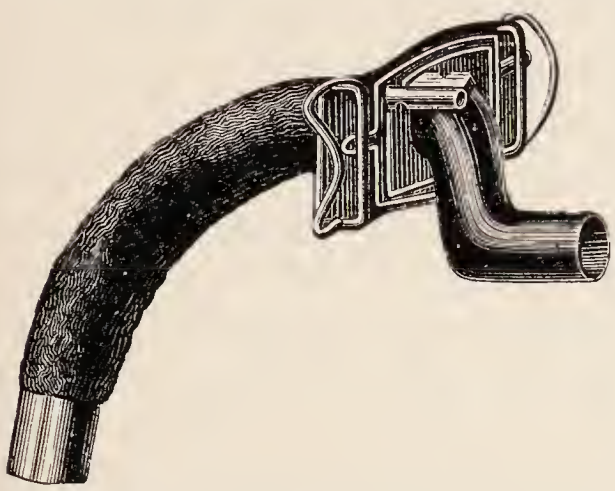


FIG. 1285.—Tampon after Hahn and Michael.

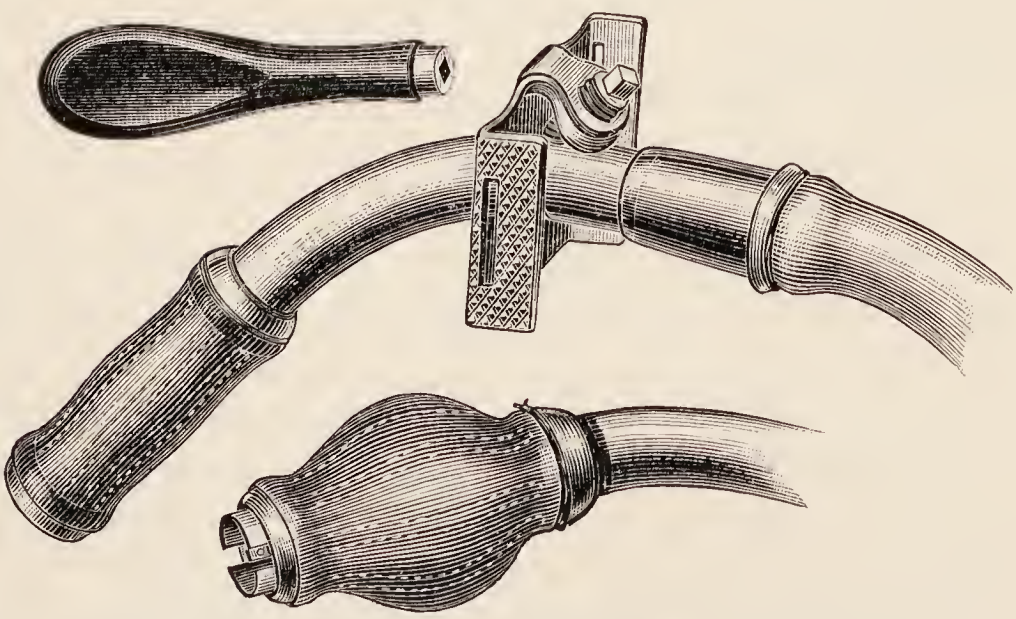


FIG. 1286.—Gerster's trachea tampon cannula.

method of practice. The introduction above the tube, in low tracheotomy, of pieces of iodoform gauze to arrest discharges coming from above are regarded as beneficial in diphtheria and infectious discharges from other causes.

*The Artificial Larynx* (Fig. 1287).—Within four or five weeks after operation, or when the parts are well healed, the artificial larynx may be inserted. At that time competent authority should be consulted in order to secure the most serviceable apparatus in all respects. In some instances the artificial larynx gives but little trouble and adds much comfort to the patient; in others its use is but little cultivated and often quickly discarded. Gussenbauer's artificial larynx consists of a long tracheal tube and an upper short speaking tube. Wolff's apparatus is by some regarded more efficient than the former. A T-shaped tube is preferred by some patients, although it affords only the lisping voice. Methodical exercise will often enable a patient to speak aloud without the use of an artificial appliance.

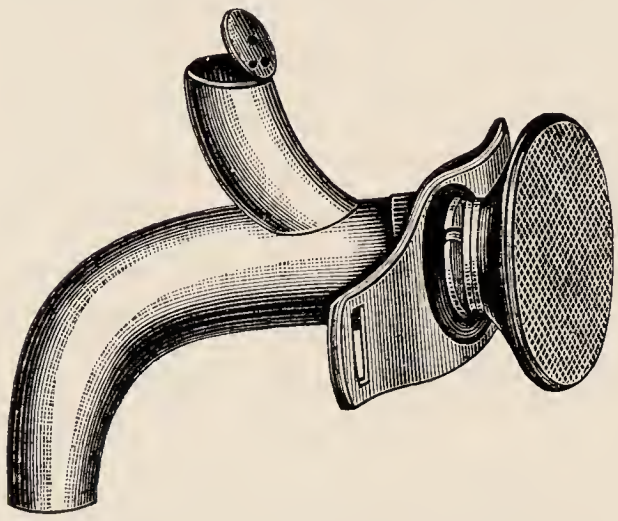


FIG. 1287.—Gussenbauer's artificial larynx.

*The Results.*—The operation has been performed upward of 300 times, over two thirds of which were complete removals. The rate of mortality from the operation alone is over 30 per cent in complete cases, but less in the incomplete. Early return is the rule in complete removal. According to Butlin, in 1890, the following results for operation in malignant diseases are noted after from three to twenty years have elapsed:

| | Number of cases. | Deaths from operation. | Cures. |
|---|---|---|---|
| Thyrotomy | 28 | 3 | 3 |
| Partial excision | 23 | 7 | 4 |
| Complete excision | 51 | 16 | 8 |
| | 102 | 26 | 15 |

Later estimates show a death rate of 22 per cent, a positive cure (three years or more) of 10 per cent, a relative cure (less than three years) of 48 per cent, and a recurrence of 20 per cent (Schmiegelow). Earlier action and improved technique will no doubt increase considerably these results.

**Operations on the Thyroid Body.**—An enlarged thyroid body is removed partially or completely, not infrequently, and otherwise surgically treated to afford relief from physical suffering and the mental disquietude which the deformity due to its presence causes. Complete removal is not practiced now except for malignant disease, on account of the unfortunate sequels due to its removal from the human economy. At the present time the following operative procedures are employed in the surgical treatment of goitre: 1, Partial excision; 2, enucleation—resection; 3, enucleation; 4, ligature of

the arteries and exothyropexy. Complete excision is practiced in malignant cases only, and with great conservatism.

*The Anatomical Points.*—The relations of the normal thyroid body to the trachea, œsophagus, recurrent laryngeal nerves, and to the carotid sheath and its contents, should be given careful consideration before beginning the operation. The shape, size, nature, and extent of the growth will modify in a marked degree its normal relations to important structures, and have much to do to establish or disprove the idea of operative action. The inferior thyroid arteries are larger than the superior, but the anastomosis between them all is of the freest kind. The right superior thyroid artery was absent in a case of removal by the author. The arteria thyroidea ima supplements often the deficiency due to anomalies of the regular arterial supply of the body. The superior and inferior thyroid veins are of large size, are intimately associated with the arteries of the same name, and empty their blood into the internal jugular and innominate veins respectively. The superior thyroid arteries approach the anterior and upper parts of the organ which they mainly supply. The inferior lie below and posteriorly to the organ, and supply chiefly the corresponding portion of this body. The recurrent laryngeal nerves are closely and indefinitely associated with the inferior arteries, and for this reason extra care is needed to prevent injury of them during ligature of these vessels. The sympathetic nerves and the middle cervical ganglion are in quite intimate relations with the inferior thyroid arteries, and great care should be exercised to avoid injury of them. Portions of glandular tissue of small size and separated from the main structure are found from the arch of the aorta to the hyoid bone. These accessory bodies are of much importance, as they may become the seat of carcinomatous growths. The location of the third lobe and its relation to the isthmus and to contiguous structures should be noted. It is sometimes the seat of disease, and it is important to know that when healthy it often remains behind in complete extirpation of the major lobes. The thyroid body is covered in front by the sterno-hyoid, the sterno-thyroid, the omo-hyoid, and the anterior border of the sterno-mastoid muscles. It lies between two layers of fascia which unite above and are attached to the cricoid cartilage. A distinction should be made between the fascial covering and the proper capsule of the thyroid body, otherwise great confusion will attend the isolation of the gland from its contiguous tissues. The atrophy of the tissues overlying the enlargement may be mistaken for the capsule of the thyroid body itself.

*The preparation of the patient* is not essentially dissimilar from that for operations generally at this region. The usual local aseptic measures are practiced. The bowels should be unloaded freely the day before the operation to obviate the need of defecation for the first few days afterward. Chloroform anæsthesia is preferable in this as in most other operations at this situation. The patient is placed on the back, with the shoulders raised, and the neck extended and well exposed.

*The Operation of Partial Excision* (Kocher).—Either a transverse or angular incision may be employed. If the tumor be small and cosmetic

gain be important, make a liberal transverse incision with a slightly upward convexity along the line of cleavage of the skin, across the most prominent part of the tumor, through the integument and platysma, catching the superficial vessels and dividing them between two ligatures; divide the fascia and expose the spread-out fibers of the sterno-laryngeal and sterno-mastoid muscles; divide the former muscles and the border of the latter so that the tumor may be freely exposed (Fig. 1288). The further detail is stated under operation by angular incision (page 1089).

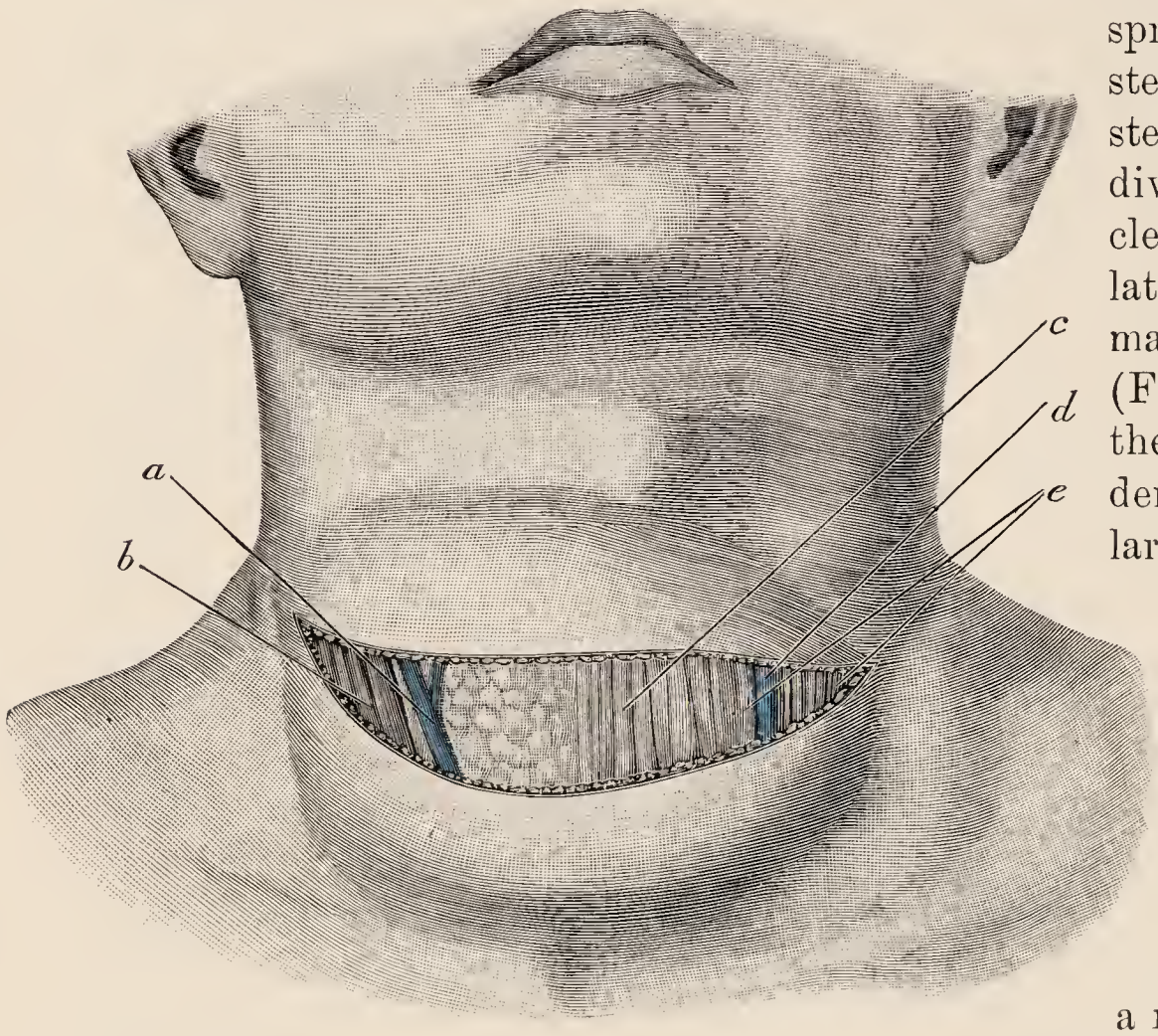



Fig. 1288.—The operation of excision of goitre of the right side, Kocher's method. *a*. Branch of communication between anterior and external jugular veins. *b*. Sterno-cleido-mastoid muscle. *c*. Sterno-thyroid muscle. *d*. Anterior jugular vein. *e*. Sterno-hyoid muscle.

*The Remarks.*—Although the transverse incision is followed only by a minimum degree of scarring, the retraction of the divided muscles often causes a marked and even ugly deformity. Therefore, the muscles should not be divided unless their division be necessary for a proper exposure of the tumor. If the incision be incautiously made or extended at either end the external jugular veins may be divided.

The angular incision causes a more pronounced scarring, but permits of separation of muscular fibers, thus avoiding the deformity that follows their division. Inasmuch as the operative steps are comparatively similar after exposure of the growth through either incision, and as the transverse has been described already, the angular incision and removal of the growth will be stated in detail.

*The Angular Incision.*—Commence the angular incision at the level of the thyroid cartilage over the prominence of the sterno-mastoid muscle, and extend it transversely in the direction of the skin creases to the median line of the neck, thence vertically downward even to the suprasternal notch, if the size of the tumor demands (Fig. 1289), cutting through the skin, fascia, and platysma, dividing the vessels between two ligatures as they appear; expose the fibers of the sterno-mastoid at the outer part of the incision; free the border of the muscle and draw it aside with hooks; incise and draw upward the fascia that covers the sterno-hyoid and sterno-thyroid

muscles at the middle portion of the horizontal incision; divide in the median line the fascia that connects the sterno-laryngeal muscles of the respective sides, ligaturing the vein that lies transversely above the supra-sternal notch; free the inner edges of these muscles, introduce the finger under and partially divide them at the upper ends; ligature divided vessels and draw aside with hooks the borders of these muscles, thus exposing the outer capsule of the goitre; carefully divide and strip to either side from the surface of the tumor this capsule with a blunt dissector; divide between two ligatures the transverse veins when seen stretching between the capsule and the goitre; draw aside the outer capsule along with the superimposed muscles sufficiently to permit the finger to be cautiously passed around the edge of the goitre and beneath its under surface; draw the goitre forward carefully (Figs. 1290 and 1291), tearing no vessels, especially the inferior thyroid artery and its branches, which are considerably stretched by traction; ligature the inferior thyroid artery and its veins behind the tumor as soon as they are sufficiently exposed; carefully isolate and inspect the inferior thyroid artery before ligature to avoid involvement of the recurrent laryngeal nerve (Fig. 1294, *k*). If the accomplishment of this purpose be too difficult or uncertain, it should be deferred until a later stage of the procedure. When the lower part of the tumor does not extend beneath the sternum, the large inferior thyroid vein is put on the stretch, isolated, and tied between two ligatures by drawing this portion of the tumor forward. Isolate and divide between two ligatures a branch of the superior thyroid vein which ascends toward the median line; expose the superior thyroid vessels by blunt dissection made above the isthmus at the inner border of the upper horn of the growth; draw the outer capsule and the superimposed soft parts upward, grasp the upper horn with the thumb and finger, and put on the stretch the superior thyroid vessels, which are then tied and divided; isolate and ligature the veins lying above and below the

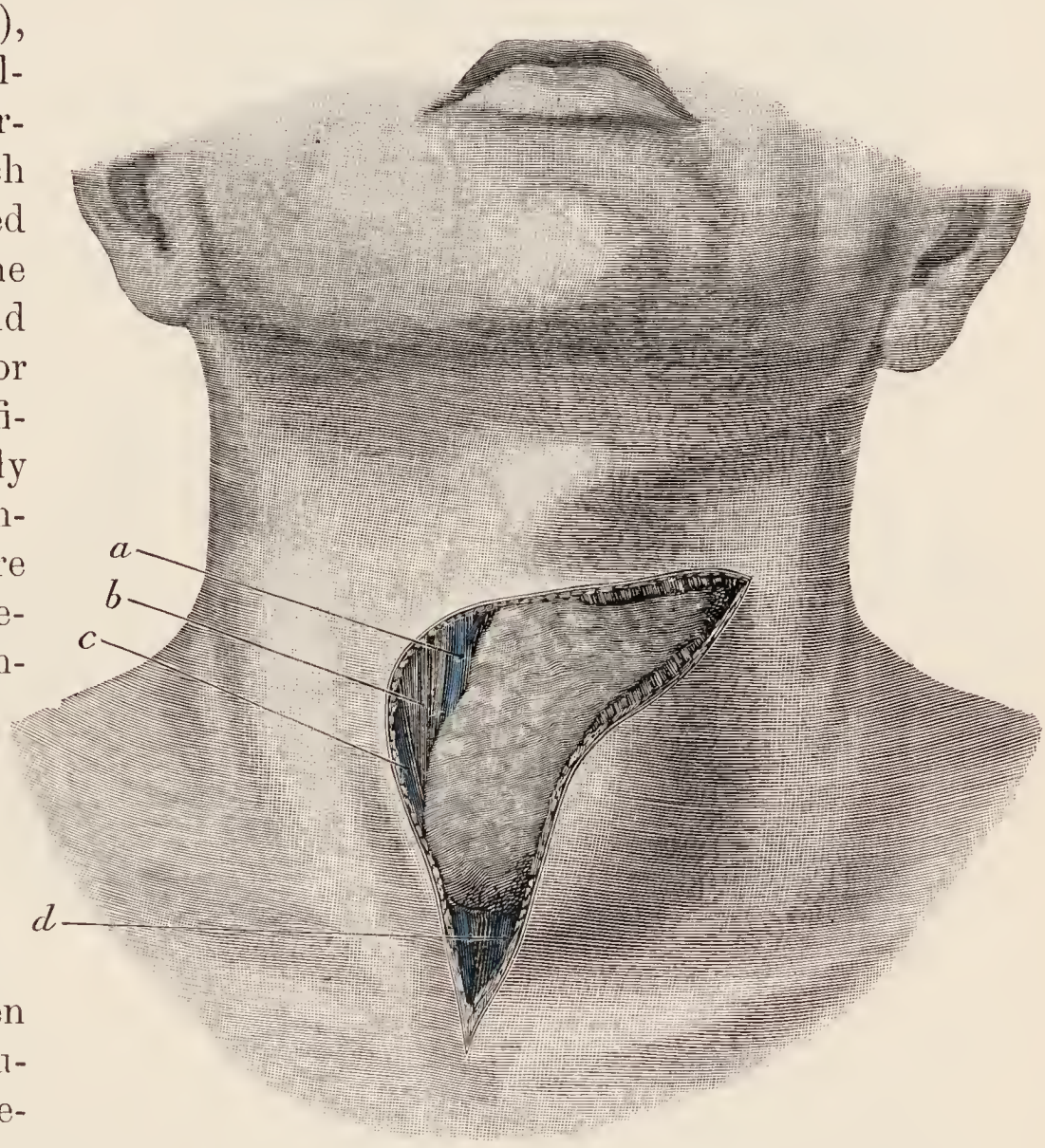



FIG. 1289.—The operation of excision of goitre of left side by angular incision, Kocher's method. *a*. Anterior jugular vein. *b*. Sterno-hyoid muscle. *c*. Communicating branch between anterior and external jugular veins. *d*. Inferior thyroid veins.

respective borders of the isthmus; insinuate carefully between the trachea and the isthmus an aneurism needle or Kocher's grooved director (Fig. 1292), and surround the latter structure by a strong silk ligature, which is tightened as the isthmus is cut across; push the fingers of the left hand under the goitre, and raise it upward while its firm attachments are being separated from the trachea. Finally, the tumor is turned carefully out of its bed while observing for the presence of, and cautiously treating, any restraining tissues.

*The Precautions.*—The patient's neck should be flexed from time to time, in order that small veins emptied by extension may fill again and escape untimely division. If the proper capsule of the growth be not entered at first, the aimless efforts to isolate it will cause great embarrassment and lead to harmful delay. The application of the ligature to the thyroid vessels at a distance from the growth, or the use of temporary ligatures, should be practiced when proper isolation of the recurrent laryngeal nerve is not assured. During the separation of the goitre from the trachea the recurrentlaryngealnerve may be injured "in spite of every care," especially where it passes beneath the lower border of the larynx. To prevent this accident Kocher advises that a posterior portion of the capsule of the growth be cut away and left behind at that situation. In instances of encapsulated thyroid nodules, not separable posteriorly from the internal thyroid capsule, the capsule must be cut through, but not sufficiently near to the trachea to beget a dangerous removal. The possible adhesion of large growths to the jugular vein should not be overlooked. Undue compression upon or a kinking of the pressure-softened trachea by rough handling may cause alarming and perhaps fatal dyspnœa.

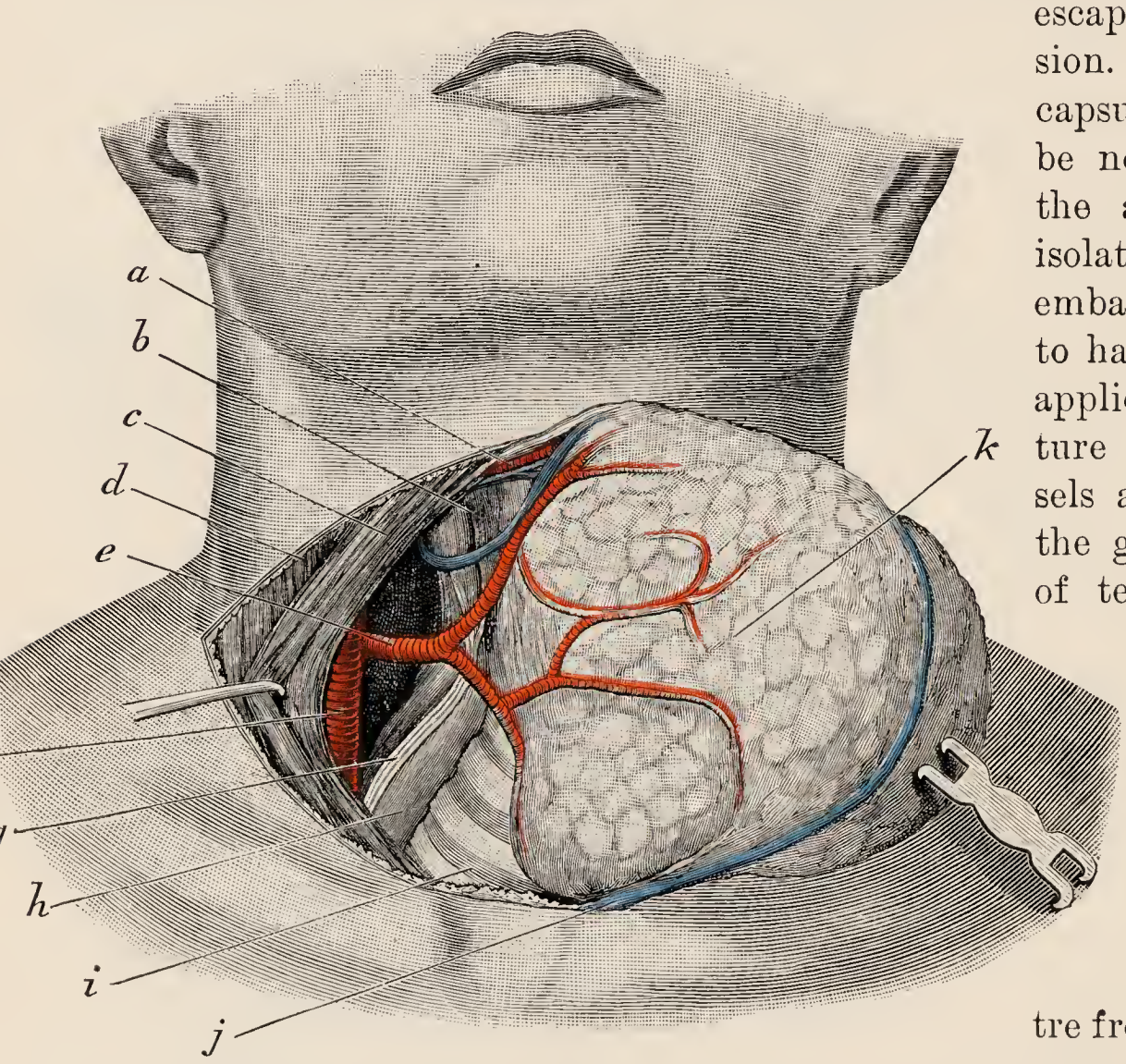



FIG. 1290.—The operation of excision of goitre of right side through transverse incision (Fig. 1288), Kocher's method. *a*. Superior thyroid artery and vein. *b*. Posterior border of thyroid cartilage. *c*. Sterno-hyoid and sterno-thyroid muscles. *d*. Sterno-cleido-mastoid muscle. *e*. Inferior thyroid artery. *f*. Right common carotid artery. *g*. Right recurrent laryngeal nerve. *h*. Œsophagus. *i*. Trachea. *j*. Inferior thyroid vein. *k*. Right half of goitre turned out toward the left side.

Since the hæmorrhage and the peculiar fever that often follow operation are increased in direct proportion to the amount of laceration of the thyroid body attending the removal, needless injury of the structure should be carefully avoided. Remove promptly fluid collections from the pharynx to prevent strangulation. Vertical incisions for removal of goitre should rarely be made.

*The Comments.*—A pair of blunt-pointed scissors curved on the flat are efficient instruments for enucleation purposes. A bronchocele may not only surround the trachea, but so insinuate itself with other important structures as to make the removal impossible, or the attempt unjustifiable. Kocher advises the employment of local anæsthesia in all cases attended with marked dyspnœa. General anæsthesia causes engorgement of the vessels, increases the hæmorrhage, and incites secondary bleeding by consequent vomiting. *Kocher* advises the use of a one-per-cent solution of cocain in all suitable cases, and regards the dangers as being greatly lessened by local anæsthesia. But little pain is caused, and the consciousness of the patient will permit of his co-operation, and of the recognition of involvement of the recurrent laryngeal nerve by noting the character of the voice. Blind and hurried clamping of bleeding points should not be practiced in this operation.

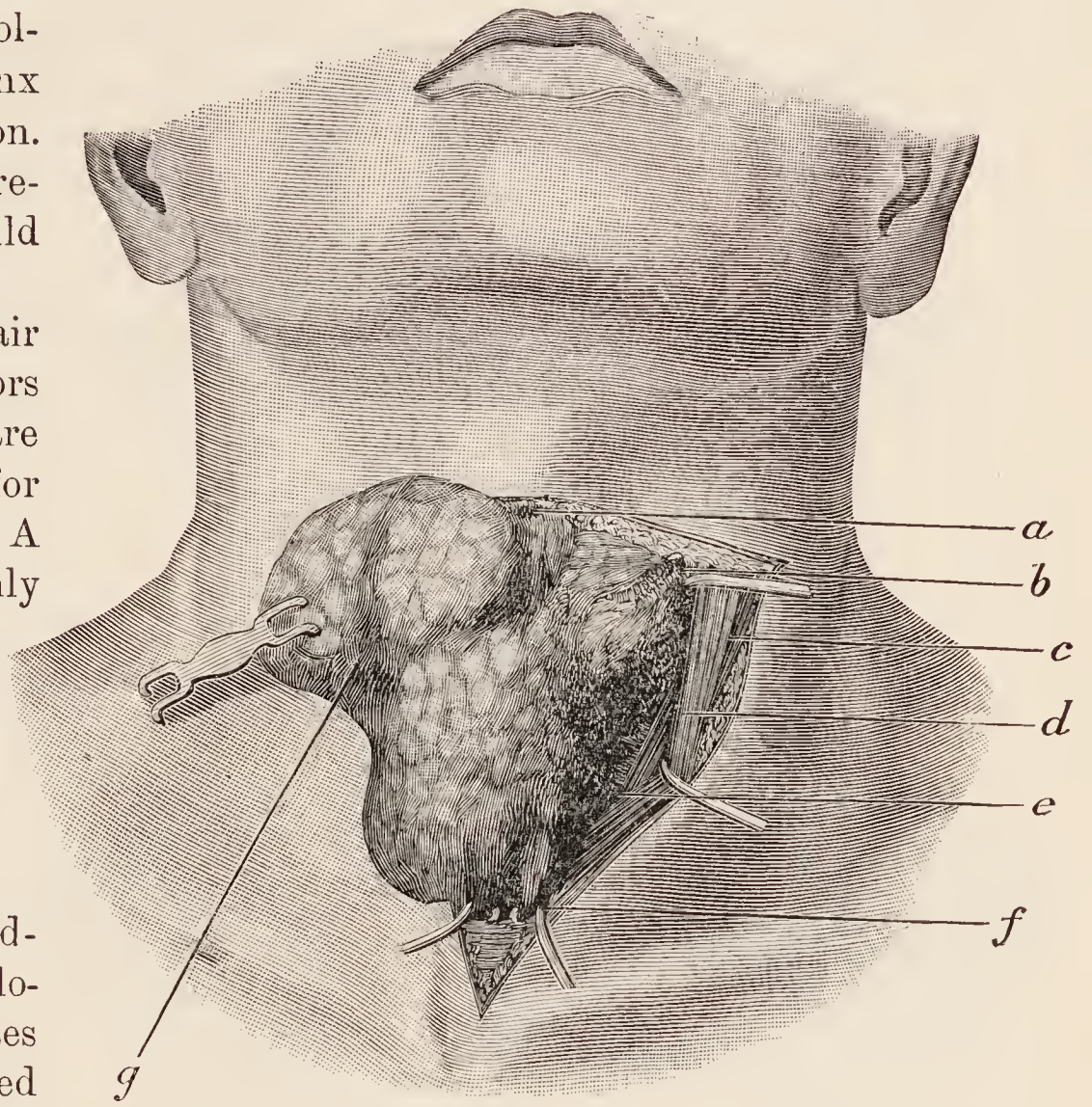



Fig. 1291.—The operation of excision of left-sided goitre, angular incision, Kocher's method. *a*. Superior thyroid vein. *b*. Superior thyroid vessels. *c*. Sterno-mastoid muscle. *d*. Sterno-hyoid muscle. *e*. Inferior thyroid artery. *f*. Inferior thyroid vessels. *g*. Goitre dislocated to the right over trachea. The inferior and superior thyroid arteries and veins are ligatured.

**Enucleation—Resection** (Kocher).—Enucleation-resection is advised by Kocher as being superior to enucleation, because of the severe hæmorrhage that often attends enucleation, and the resulting need of packing the wound; also the consequent danger of sepsis, the delay in healing that follows packing, and the less certainty of permanent cure in cases of multiple growth and those of questionable nature, than when excision is practiced. *Wölfler* concurs in these reasons.

Expose the goitre through the transverse or angular incision, as seems

best; dislodge the growth as before described (page 1089), omitting ligature of the vessels; ligature and divide the isthmus as in the preceding instance (page 1090); expose the inner border of the nodule to be enucleated through the cut following division of the isthmus; separate the nodule from the overlying gland tissue with a blunt dissector; divide the overlying gland tissue along the line indicated by the needles (Fig. 1293) between two ligatures; separate the nodule at the upper and lower parts from the inner capsule with the finger; free a fair extent of the posterior surface in the same manner; divide the posterior part of the inner capsule vertically at the posterior surface with scissors, so that the cut opens into the line of section made just before at the anterior surface (Fig. 1293, *k*); remove the nodule and the part of the gland lying in front of it, and close the wound.



Fig. 1292.—Kocher's grooved director for operations on goitre.

*The Precautions.*—In cutting away the thyroid structure, do not approach sufficiently near to the trachea to invite danger to it or to the laryngeal nerve.

**Enucleation** (Socin).—Expose the surface of the goitre through a median incision, or one made over the anterior border of the sterno-mastoid, according to the prominence of the growth (Socin). Separate the sterno-laryngeal muscles and draw their borders apart; draw aside the omo-hyoid if practicable, if not, divide it; expose the surface of the tumor by division of the overlying tissue at the situation of the nodule. It is recognized by its bluish white covering, and enucleated through the incision made down upon it, deeply or superficially, as the case may be, arresting hæmorrhage as it occurs.

*The Comments. The Incision of Kocher.*—The recurrent laryngeal nerve is not exposed to danger in this operation; the healthy structure of the organ is preserved, and deformity is prevented. Attempted cure by injection complicates enucleation. In some instances hæmorrhage is quite profuse. Temporary or permanent ligature of the arteries may be practiced. However, the indication is commonly well met by elastic constriction around the neck of the affected part of the gland (Bose). This operation is adapted to the cure of cysts and solid tumors of established size, but not to advancing goitre, as then recurrence is quite certain. A free incision may not be required for the removal of each independent cyst, as a contiguous cyst may be removed through the thin-walled compartment of another.

Enucleation is regarded by many operators with great favor. Nearly 2,700 cases are reported in which neither hæmorrhage, sepsis, nor cachexia caused death. Operative involvement of the recurrent laryngeal nerves and of other important contiguous structures are less frequent than in the more extended operations. *Shepard* strongly favors the method in both solid and cystic tumors. In their removal he adheres closely to the outer limits of each; in the latter he taps the sac, grasps it with forceps, and carefully removes it. In each instance hæmorrhage is arrested by ligature and gauze

packing, the wound sutured above and left open below for removal of the gauze.

**Resection of Goitre** (*Thyroidectomy*) (Kocher).—Resection of the growth is sometimes practiced for relief from the severe pressure symptoms incident to colloid degeneration of both lobes, or of the malignant complications, as well as for their cure. A long transverse incision is made with an upward extension at both ends, followed by a free transverse division of the muscles, with ligature of the main vessels of one side and a vessel above or below on the other side. When practicable forward, successive luxation of the respective halves of the growth is done, and resection practiced under elastic tension, supplemented with numerous artery forceps. In this way only can partial removal of both lobes be practiced without extensive hæmorrhage when cutting through the thyroid tissue. The overlying structures involved in malignant growths should also be dissected away.

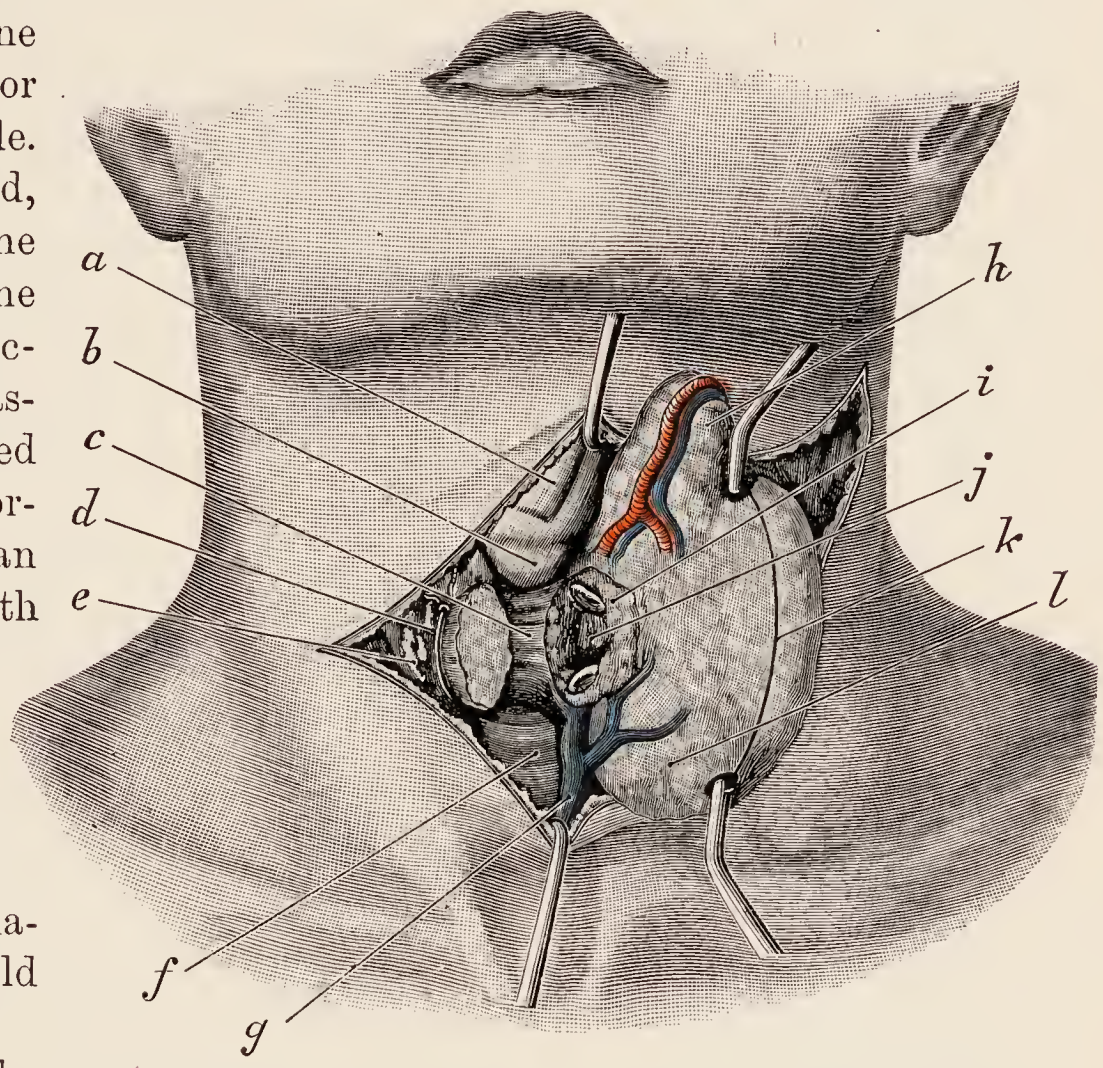



FIG. 1293.—The operation of enucleation—resection of a hypertrophied nodule from the left lobe, Kocher's method. *a*. Angle of thyroid cartilage. *b*. Cricoid cartilage. *c*. Piece of posterior portion of capsule of goitre. *d*. Ligatured isthmus. *e*. Healthy portion of thyroid. *f*. Trachea. *g*. Inferior thyroid vein. *h*. Upper horn of thyroid and superior thyroid vessels. *i*. Cut surface of isthmus. *j*. Surface of nodule. *k*. Line of division of capsule of goitre at posterior surface. (This line is located too far forward.) *l*. Lower horn of thyroid. The left lobe is dislocated through the incision, isthmus ligatured, cut across, and the cut surfaces drawn apart so as to expose nodule.

*The Remarks.*—At the best, resection of a goitre is a difficult and often a dangerous measure. In this class of cases difficulty of breathing is frequently present. And in these, as in others similarly afflicted, ether is contraindicated. Slight morphin narcosis and cocain anæsthesia should be employed instead. In so-called complete extirpation a small portion of gland is left, and often a pyramidal process (third lobe) remains. Ligature and division of the isthmus has been advised for the relief of pressure dyspnœa in inoperable cases. *Wölfler* practiced "operative dislocation" for the same purpose, the goitre being raised from its bed without cutting the arteries, and transplanted to a more favorable situation. In malignant disease the fatal outcome is so pronounced as to almost forbid the practice. Thirty-three per cent die from the operation,

and 60 per cent die within six and 84 per cent within eight months after operation.

**The Treatment by Ligature of the Thyroid Arteries.**—The ligature of the superior thyroid is not difficult or especially dangerous (page 173). Ligature of the inferior thyroid is more difficult, and incurs special dangers from the involvement of important structures (page 153). *Kocher* reaches the vessel through an incision made along the inner border of the sterno-mastoid, and ties the artery in front of the scalenus anticus. *Rydygier* made a transverse incision three inches in length, one inch above the clavicle, so that more than half the length lies behind the sterno-mastoid muscle, through which he exposes the thyroid axis, and secures and ligatures the artery.

*The Comments.*—The rapidly developing parenchymatous, vascular goitres, especially in the young and those unfitted for enucleation, are proper cases for treatment by ligature. The gradual atrophy following simultaneous ligature of both of the arteries does not appear to expose the patient to the common sequels of complete removal of the thyroid body. The vascular goitre of Graves's disease is suited to this procedure. *Trendelenburg* ties the arteries of one side, a month later those of the other. *Wölfler* and *Porta* have practiced the same with favorable results. *Kocher* advises that the artery supplying the portion of the thyroid involved should be tied first, and be followed by ligature in order of the vessels supplying succeeding enlargements, provided that a beneficial effect be noted. The different plans of action advised, and the uncertainty of the outcome from the ligature, together with the difficulty attending it in many instances when compared with the established technique and success of the radical methods, leave but a limited field of utility in this disease for ligature.

**Exothyropexy** (Jaboulay).—Exothyropexy consists in freeing the gland from its capsular environment, raising and fixing it superficially in the wound, and leaving it to granulate and adhere under antiseptic dressing. The influence of exposure to air, and of resulting venous sinus thrombosis, contribute to the shrinkage. *Poncet*, *Wölfler*, and others have secured in this manner a limited shrinkage of the gland. The presence of thrombosis and the laceration attendant on the displacement are elements of danger from systemic infection. In cases of threatened suffocation high or low tracheotomy, according to the size and situation of the goitre, with the introduction of a tube suited to the peculiar requirements of the case (Fig. 1270), is a wise preliminary step and often a proper final measure. It seems especially fitted for the relief of dyspnœa of parenchymatous and other inoperable goitres. Larger experience is required to establish the practicability of the measure.

**Excision of the Sympathetic.**—*Jaboulay* and *Jonnesco*, have advised and practiced this measure for the relief of patients with exophthalmic goitre (page 1282).

**The injection of goitre** for cure is now practiced much less than formerly. Injection should not be employed at all in cases for which operation is contemplated, on account of the periglandular adhesions that it causes, which beget special difficulties in the event of subsequent operation. The

cystic and recent follicular varieties are those to which the treatment is best suited. The excellent results now obtained by operation limit the use of injections to the narrow and illogical field of unsurgical expediency. The tincture of iodine (five to ten drops) and a like amount of carbolic-acid solution (five per cent) are regarded as the best medicinal agents for the purpose. Strict aseptic precautions throughout should be taken. The needle should be thrust slowly into the gland, carefully avoiding the superficial veins; the syringe is then removed to see if blood will escape through the needle, thus avoiding the introduction of the fluid into a vein. Eight or ten drops of the fluid are then slowly injected, watching carefully the effects of the introduction. But one injection is made at a sitting, and an interval of three or four days should have elapsed before it is repeated. Different aspects of the tumor are subjected to treatment. *Senn* speaks in high terms of the carbolic-acid treatment established by Gunn. *Schwartz* regards iodine as the most efficacious and least dangerous for ordinary cystic goitre. *Heymann* reports 16 deaths from injection, one of which happened suddenly after the use of iodine, which had been injected twice per week for four months.

**The Dangers of the Operations.**—Hæmorrhage is a constant danger during, and it may happen after, the operation. If care be exercised to divide nothing incautiously and to divide the vessels between two ligatures, but little annoyance is likely to happen from this cause during operation, unless the growth be a soft and highly vascular one, when a startling and profuse bleeding will be provoked by opening the capsule. The difficulty of finding and securing the bleeding points in such cases is often trying, and may seriously test the composure of the surgeon. If careful scrutiny be exercised to detect bleeding points before the wound is closed, and the ligatures have been securely placed during operation, no rational fear need be felt regarding hæmorrhage thereafter. The danger of the entrance of air into the veins is especially prominent here because of their great number, large size, and intimate relation with the influence of respiratory aspiration. These same peculiarities contribute to the danger from the use of injections, and the presence of thrombi and infecting agents.

*The Recurrent Laryngeal Nerve.*—If this nerve be cut, bruised, or included in a ligature during operation, serious laryngeal manifestations may occur at the time or may happen afterward. Undue dragging on the nerve, its involvement in cicatricial formation, or the presence of neuritis may cause aphonia after operation. Fortunately, however, these manifestations are not always permanent. Large, adherent, illy-defined tumors are dangerous for this reason, as are those surrounding closely the trachea and œsophagus. A subsequent operation may be necessary to relieve these symptoms. The lymphatic duct, especially the right, may be bruised or torn during the removal of large or low goitres. The distinctive appearance of the lymph will suggest the nature of the structure involved.

*Cellulitis.*—Cellulitis of a septic nature may follow operation even for small growths, and lead to the formation of pus in the mediastinum. A scrupulous aseptic technique will obviate this danger.

*Cachexia Thyreopriva.*—Cachexia thyreopriva manifests its presence by a species of tetany and myxœdema. The continued and frequent occurrence of these sequels in complete extirpation led to its abandonment except in malignant disease. The removal of a greater or lesser fractional part of the gland may be followed by these sequels in a minor degree. However, the best evidence of their infrequency is witnessed by the fact that in 1,600 cases of operation by Kocher's method but 4 suffered from this sequel.

*The dressing of the wound* requires no especial technique. The cavity of the wound is flushed with an aseptic solution or wiped dry; loose clots are removed, and all bleeding points are arrested. The margins of the wound are carefully united with silkworm-gut sutures, and drainage is employed at the dependent parts. The walls of the wound are pressed together and dead spaces eliminated by catgut sutures, and sponge pressure carefully adjusted and equalized by a thick covering of absorbent cotton held in place with bandages. If the bandages are applied too tightly much discomfort will follow. A mild pharyngitis, attended with profuse expectoration of mucus, often occurs, as in other operations on the neck, at the sides, and at the median line.

*The after-treatment* is of a routine character. The head is kept flexed as much as comfort will permit, and the dressings are changed to conform with needed cleanliness. The drainage is removed after a day or two. The food should be bland and nutrient, and fresh air freely provided.

*The Results.*—The 40-per-cent death rate of forty-five years ago was reduced to 21 before 1871, and to 11 per cent before 1877. In 1895 Kocher reported 1,000 cases of benign goitre operated on by himself, with an operation death rate of 1 per cent. To this list can now be added 700 others, of which Kocher performed 550 and his assistants the remainder. The last 600 of this series includes 18 malignant and 15 exophthalmic cases, and still the average death rate is but 1 per cent. *Krönlein* and *Sulzer* report 200 and 144 cases respectively without a death. A 2-per-cent rate of mortality is now a fair estimate of the results of experienced hands in benign cases. The outlook in malignant cases is gloomy. Kocher's operative death rate is 33.33 per cent. The average duration of life is about six months (Orcel); 84 per cent die in six and 60 per cent in eight weeks (Rotter). In exophthalmic goitre the rate of mortality from operation is well shown by the cases collected by Starr. In 190 cases 74 were cured, 45 improved, 3 unimproved, and 23 died from the operation. The remaining 45 not stated. The mortality rate varies from 7 (Kinnicutt) to 12 or 15 per cent, depending on the judgment and operative skill of the surgeon.

**Wounds of the Neck.**—Incised, stab, and gunshot wounds of the neck are of not infrequent occurrence. Incised wounds happen oftenest because of suicidal attempts. The location and extent of the incision modify its severity. If at the front and above the hyoid bone, the base of the tongue may be involved, if through the thyroid space, the epiglottis and pharynx (Fig. 1276), if lower, the larynx and trachea respectively may be involved. Incision through the thyro-hyoid space occurs most frequently. If the wound be superficial, but little harm may arise; if deep, free division of the air passage and per-

haps of important vessels on either side is followed more or less promptly by death from hæmorrhage or asphyxia, unless relieved. Deep wounds, involving the spaces immediately above and below the hyoid bone, incite suffocation from the closure of the larynx by the down-falling of the base of the divided tongue and of the divided epiglottis respectively. Inflowing blood is an important element of immediate and remote danger in all instances of air-passage involvement, causing infection in the first and septic inflammation of the lungs and bronchi in the latter instance. Œdema of the glottis and emphysema of the connective tissue are common and important complications of these wounds, the former happening most frequently with upper and the latter with lower involvements of the air passages. The importance of gunshot and stab wounds relates to the direction and extent of injury. The important vessels and nerves, the œsophagus, the trachea, and even the pleural cavity and lung itself, may be involved in these injuries.

Fracture of the larynx and hyoid bone may result from direct blows and from manual choking. These injuries may so deform and cripple the parts as to threaten suffocation in the former, and cause much pain and annoyance in the latter instance.

*The Treatment.*—The treatment is regulated by the urgency of the symptoms. Severe hæmorrhage and asphyxia demand instant arrest of bleeding, the removal of obstruction, and the performance of tracheotomy, if then required. When time will permit, thorough asepsis should be practiced. In wounds involving the air passages the arrest of bleeding is of double significance, preventing the entrance of blood into the respiratory passages as well as the loss to the patient. Temporary tracheotomy is usually required in wounds of the trachea, the larynx, and the pharynx, especially the latter two, in order that the danger incurred by the sudden advent of œdema of the glottis may be forestalled. Wounds of the trachea may be closed with catgut at once and tracheotomy omitted. In wounds of other kinds the tube may be inserted at the seat of injury or through a high tracheotomy, if the location of the wound permits. In wounds involving the pharynx, tracheotomy is often advisable as the best means of avoiding the septic exposures arising from discharges provoked by food contact, as well as the dangers of œdema of the glottis. Tracheotomy permits of careful cleansing and closure of the original wound in many instances. In wounds of the œsophagus, infiltration of the deep tissues of the neck from swallowing food and fluid may happen before the existence of an injury is suspected. In stab and gunshot wounds of the trachea extensive and dangerous emphysema may arise, requiring tracheotomy and free incision for relief. A gunshot wound of the neck, passing contiguous to but not involving the trachea, and entering the lung, may cause extensive emphysema and otherwise simulate in all important respects a wound of the trachea. Œsophageal wounds should be exposed at once, cleansed, and, if clean cut, sutured. Ragged wounds, howsoever inflicted, should be treated by drainage and packing. In no instance is it wise to completely close a wound in case of œsophageal involvement (page 596), because the uncertainty of union of the tube renders primary closure unsafe. Wounds of the tongue and epiglottis are sewed care-

fully at once, the divided borders of the mucous membrane of the pharynx being closely apposed by sewing before the more superficial structures are united. In all suitable instances wounds of the neck should be carefully closed. The divided borders of the muscles and gaping structures should be united with sutures to secure prompt and effective union, thus eliminating dead spaces. After suture of the soft parts the neck is flexed, and sufficient pressure is applied to cause still further the approximation and retention essential to the prevention of dead spaces and to good union. Drainage should be employed only in the instance of suspected infection. Fixed position of the neck, cleanliness, alimentation by the bowel for a day or so in case of pharyngeal wound, followed by feeding by the stomach tube, are important measures of treatment. If the head be lowered for the first two or three days, an increase of blood in the brain and the flow of the discharges away from the wound will be favored. The tracheal, the œsophageal, and laryngeal sequels should be treated as necessity demands.

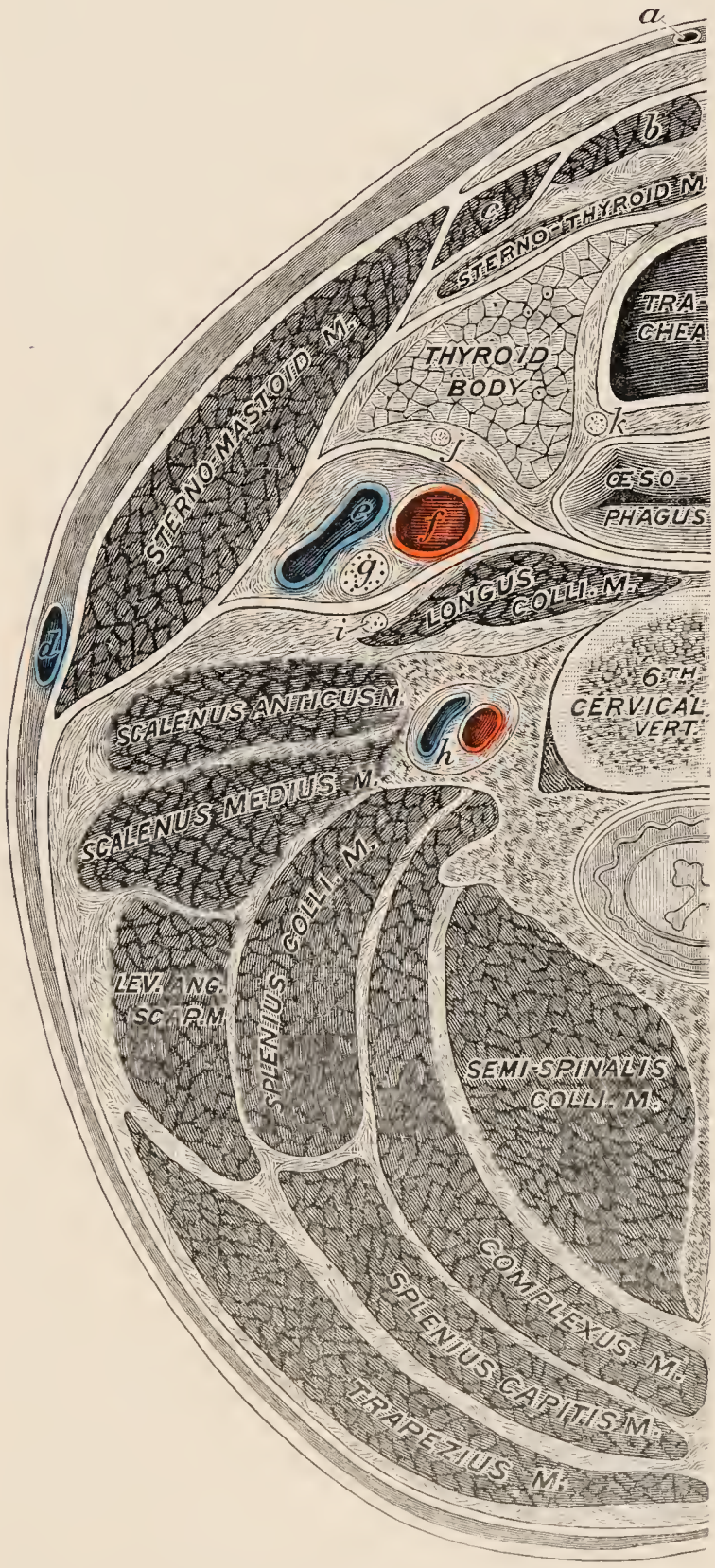



FIG. 1294.—Arrangement of the deep cervical fascia, muscles, vessels, nerves, etc., as shown by transverse section on level with sixth cervical vertebra. *a*. Anterior jugular vein. *b*. Sterno-hyoid muscle. *c*. Omo-hyoid muscle. *d*. External jugular vein. *e*. Internal jugular vein. *f*. Common carotid artery. *g*. Pneumogastric nerve. *h*. Vertebral vessels. *i*. Sympathetic nerve. *j*. Descendens hypoglossi nerve. *k*. Recurrent laryngeal nerve.

**Abscess and Phlegmon of the Neck.**—Abscess and phlegmon of the neck located in the sublingual (Ludwig's angina), submaxillary, and parotid regions, also at the anterior and lateral cervical regions from glandular involvement, not infrequently occur. In each instance early relief should be sought by free incision.

The awaiting the presence of fluctuation while encouraging its appearance by poultices, etc., is often fraught with grave dangers from purulent and serous infection, infiltration of the deep tissues of the neck, and œdema glottidis, especially in those cases located below the inferior maxilla. Extensive sloughing of the connective tissue of the neck,

attended with fœtid gas, have been seen by the writer. The relief of the tension, prevention of sloughing, and extensive infiltration of morbid products, even into the thorax, requires early and decided action. Also the liability to sudden and fatal œdema of the glottis demands the exercise of the forethought necessary to meet and relieve the complication at once by bronchotomy (page 666).

**Retropharyngeal Abscess.**—Retropharyngeal abscess is not an infrequent affection, especially in children. Phlegmonous inflammation of the pharyngeal tissues, the softening of diseased lymphatic glands, and caries of the bodies of cervical vertebræ are frequent causes of this variety of abscess.

*The Anatomical Points.*—The relations of the various extensions of the deep cervical fascia to the œsophagus, pharynx, and the other deep structures of the neck (Fig. 1294), together with the fact that the lower limit of the pharynx corresponds to the intervertebral disk of the fifth and sixth cervical vertebræ, and the liability of the extension by burrowing of post-pharyngeal suppuration into the thorax, are individually and collectively important items (Gerster). Retropharyngeal abscess may be opened internally through the pharynx and externally through the neck at two situations.

The evacuation through the mouth is not advisable, except in the instance of small collections of pus dependent upon transient causes. The chronic discharge of pus into the pharynx is objectionable from nearly every standpoint, and especially when the disease is thus protracted by inefficient drainage and inadequate cleanliness. If it be determined to evacuate the abscess through the pharynx, cleanse the part thoroughly, place the patient on the back in a good light, cocainize the mucous membrane, fasten the jaws apart, seize the tongue and draw it forward. The end of the left index finger is placed against the prominent fluctuating point, and the patient is caused to inspire deeply. A sharp-pointed bistoury, its blade protected, except at the point, with adhesive plaster, is then (Fig. 734, *G*) carried along the finger into the abscess, and an opening is made downward or upward, according to the location of the point of greatest prominence, half an inch or so in length (Fig. 1295). As the fluid escapes, the finger is withdrawn, and the patient turned over and caused to expire forcibly, so as to clear the throat of the discharge. Sponging with sterilized water, to remove the pus and promote cleanliness, is practiced from time to time until healing takes place. In every instance when extended suppuration is anticipated, the evacuating incision should be made from without, behind, or in front of the sterno-mastoid muscle.

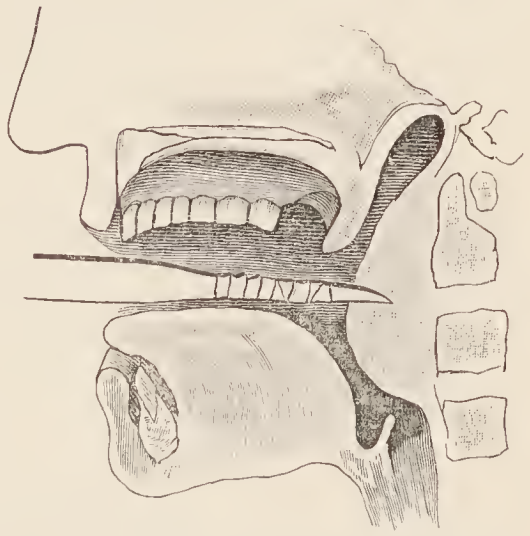


FIG. 1295.—Opening a retro-pharyngeal abscess.

**Chiene's Method.**—*Chiene* made an incision from the mastoid process downward along the posterior border of the sterno-mastoid muscle the proper distance through the integument and fascia, drew the posterior border of the muscle forward and passed in front of the scalenus anticus,

(Fig. 1294) behind the deep vessels and the longus colli to the retropharyngeal space, by means of blunt dissection.

This plan of evacuation is a comparatively simple one, as no important structures intervene. The course is direct, the drainage quite dependent, and any resulting disfigurement is at the side rather than in the front of the neck.

**Buckhardt's Method.**—*Buckhardt* made an incision at the anterior border of the sterno-mastoid muscle, at the level of the larynx, through the skin and platysma, and reached the vessels of the thyroid body, which he pushed aside. The carotid sheath was quickly exposed and drawn outward along with its contents by means of a hook. The prevertebral fascia covering the longus colli (Fig. 1294) was quickly opened, and the prevertebral space promptly gained by blunt dissection directed transversely inward across the muscle. The only vessels directly in the course of this dissection were a small subcutaneous vein, which was tied between two ligatures, and the thyroid vessels, which were pushed aside. The route by the latter method is somewhat shorter, and the field of disease is more easily exposed. However, the drainage is less free and the disfigurement more prominent than in the former.

*The Remarks.*—Tuberculous products, foreign bodies, and diseased bone should be removed carefully, suitable drainage introduced, cleanliness secured, and repair encouraged by the recognized antiseptic means.

*The Results.*—Little or no danger arises from the operation if conducted antiseptically and with care. The final outcome is dependent on the nature of the disease causing the abscess.

**The Removal of Diseased Cervical Lymphatic Glands.**—The devious and unforeseen relations that exist between diseased cervical glands and the important superficial and deep structures of the neck, invest their removal with a sense of responsibility that often begets a strong feeling of uncertainty as to the wisdom of the attempt in many instances. Apparently simple cases often become, as the operation progresses, difficult and complex, and sometimes even dangerous of execution. It is wise, therefore, that the patient or the friends be given at the outset a quite definite idea of the uncertainties that too often are a serious part of the procedure. At all events, they ought not to be permitted to regard the operation as trivial. The glands may be more or less firm and independently encapsulated or broken down and adherent to each other. Caseous and inflammatory products may take the place of or mingle with definite gland structure. The superficial and deep series of glands may be affected independently of each other, but usually they are diseased conjointly, although in an irregular and often unexpected manner. An easily removable diseased superficial series may communicate freely with a deep one that is intricately associated with important structures.

*The Anatomical Points.*—Before attempting the removal in pronounced cases, the course and relation of the superficial and deep nerves and vessels should be reviewed. The superficial branches of the cervical plexus are especially exposed to division. The cervico-facial branch of the facial nerve

and its terminal branches may be injured, causing objectionable paralysis of the lower lip. The relation of the spinal accessory to the upper end of the sterno-mastoid is of great importance. The relation of the superficial and deep glands with the sterno-mastoid muscle, and the latter with the deep glands of the neck, are matters of great significance. Any good text-book on anatomy will illustrate forcibly these important features. The presence and location of the lymphatic ducts should not escape attention.

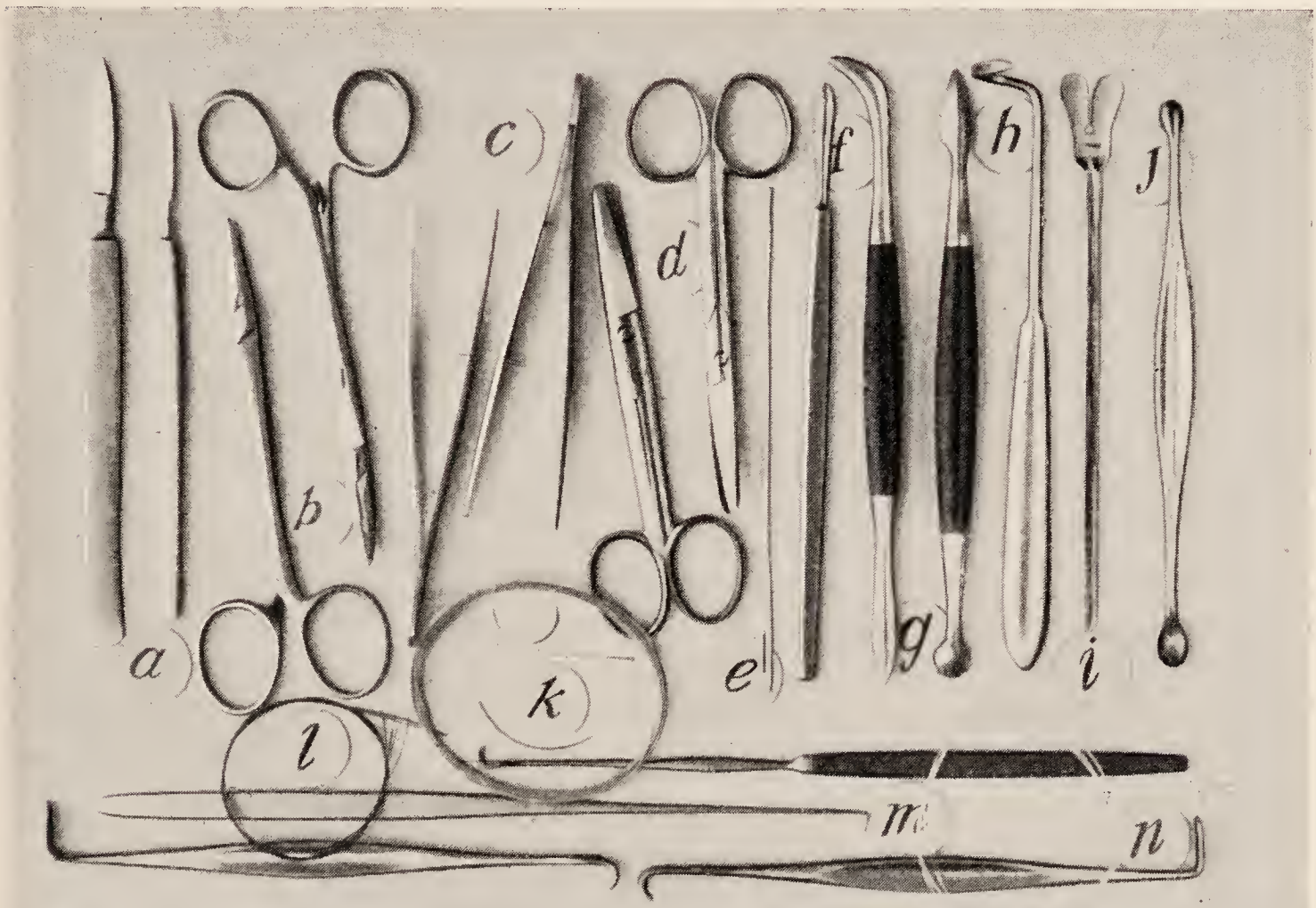



FIG. 1296.—The instruments employed in removal of diseased cervical lymphatic glands.

*a*. Scalpels, large and small. *b*. Forcipressure, curved and straight. *c*. Forceps, dissecting and mouse-tooth. *d*. Scissors, short blunt-pointed straight, and curved on the flat. *e*. Probe. *f*. Blunt dissectors. *g*. Sharper blunt dissector. *h*. Aneurism needle. *i*. Grooved director. *j*. Small scoop. *k*. Needles and catgut. *l*. Horsehair. *m*. Single- and two-tined tenacula. *n*. Small hooked and blunt-pointed retractors. Wipers, ligatures, drainage agents, large retractors, and ample gauze and plaster-of-Paris bandages are needed.

*The incisions for the removal* vary in accordance with the situation and extent of the glandular involvement, the importance of the contiguous anatomy, and the liability to operative disfigurement. The transversely directed skin fold at the upper part of the neck suggests the site of an incision to obviate deformity in the removal of glands located opposite to the hyoid bone and anterior to the sterno-mastoid muscle. The glands in the lower part of the posterior triangle can be well approached through a similar incision at that situation. At other situations oblique incisions arranged to conform to the anterior or posterior border of the sterno-mastoid are advisable. The S-shaped incision of Hartley (Fig. 1297), employed as a whole or in part, as circumstances require, is a commendable one. In all

instances the incision should be made sufficiently free to afford ample room. Safety of execution should not be exchanged for cosmetic result. The patient should be placed upon the back, with the shoulders raised and the head turned to the opposite side. A good light, plenty of time and assistance, and aseptic detail should be at the command of the operator. Chloroform or A. C. E. mixture should be given to avoid congestion of the vessels, unless contraindicated.

*The Operation* (Treves).—Make a free incision along the selected line through the skin, platysma, and fascia, avoiding the division of the superficial nerves, if possible; expose and free the sterno-mastoid muscle and hold it aside with retractors when in the field of operation; divide the muscular fibers to a limited extent, and then only when necessary; divide the deep fascia and expose the capsules of the enlarged glands; turn out the glands with the handle of the scalpel or a similarly shaped implement, if they be non-adherent; if adherent, attack the aggregation at the point least firmly fixed, keeping close to the capsules throughout the dissection, and removing adherent portions of the same; dissect out, rather than tear out a mass of tissue, as the latter procedure ruptures the connective vessels, the nerves, and also the capsules, smearing the tissues with the disorganized gland structure; relax and examine constricting bands of tissue before division, as they may contain vessels, nerves, etc., and when in doubt regarding the presence of the former divide the tissue between constricting agents; isolate torn vessels, and tie above and below the rent with catgut; search carefully for isolated and deep-seated glands, leaving none behind, unless their removal as a whole begets unwarranted danger, and in such as these divide the capsule and dig away the contents, removing the capsule afterward, if practicable; flush out the wound with an antiseptic solution, removing blood clots and arresting all bleeding points; close the wound with deep and superficial sutures, eradicating all dead spaces; introduce drainage in deep wounds, those with lacerated borders, and in any in which diseased tissue remains behind; apply antiseptic dressings with overlying sponges for compression, bandaging them as firmly in place as the respiratory and circulatory functions of the neck of the patient will permit.

*The Precautions.*—Avoid rupturing the diseased glands, as consequent infection of contiguous freshened surfaces may follow. In such instances careful cleansing should be practiced at once. Incautious attention and indifference to anatomical details during removal of these glands leads to unnecessary division of the superficial nerves, especially the superficial cervical. This nerve passes across the neck on either side, nearly opposite the thyroid cartilage. The spinal accessory is exposed in operations at the upper part of the posterior triangle, but can be readily recognized, when irritated, by the causing of contractions of the muscles it supplies. The phrenic, pneumogastric, recurrent laryngeal, descendens hypoglossi, the primary cords of the brachial plexus, and the cervical sympathetic nerves are in but little danger except in extensive involvement of the deep series of glands, or during removal of deep-seated growths of a different nature. Under similar circumstances, the apices of the pleural cavities—which

extend above the first rib at either side to the body of the seventh cervical vertebra, and higher in the female than in the male—may be invaded. The right and left lymphatic ducts are also endangered by dissection at these situations. The entrance of air into the veins is a danger to be apprehended here. The prevention and treatment is considered already on page 105. "Keep close to the capsule; make no cut in the dark; be chary of cutting tissues which are only seen when put fully upon the stretch," are wise admonitions of Treves.

The effects of division of the recurrent laryngeal, sympathetic, and common motor nerves of the neck are well understood, and need no special mention. The effect of division of one or both phrenic nerves is comparatively so well illustrated by the outcome in cases of crushing attendant on fracture of the cervical vertebræ as to need only the admonition which the latter teach to impress the importance of the maintenance of their structural integrity. Regarding the pneumogastric in this connection one can do no better than to quote the conclusion of *Park*, uttered in 1895, after an able consideration of recorded cases: "Nevertheless, the preponderance of testimony is in favor of the comparative safety of attacking this nerve when involved in disease, and when too much other disturbance is not necessitated by the condition which has caused the operation."*

If injury of the thoracic duct be detected in time, and the seat of the wound can be found, repair may be made by means of interrupted sutures or by implantation (page 854), as circumstances require. Usually a knowledge of the injury occurs too late for the purpose, and even when favorably recognized, detection of the breach in the duct may not be possible. Under the circumstances direct pressure with gauze compresses is the suitable and usually successful treatment in both instances.

*The Remarks.*—The natural intimate association of the lymphatic structures with the veins bespeaks the difficulty of the removal of the former when diseased. The compressed veins become changed in their normal aspects, and therefore are often divided in spite of the greatest caution. When a vein can not be separated from a lymphatic enlargement, it should be sacrificed, except, perhaps, in the instance of the internal jugular, when the gland should be removed piecemeal if need be. Excision (page 179) of a portion of this vein between two ligatures is justifiable when it is torn or traverses a malignant growth. Normal veins of a minor size often resemble the largest ones when compressed by glandular enlargements and malignant growths. The sterno-mastoid muscle should not be divided, if possible to avoid it, as marked deformity may follow imperfect union of the divided ends.

**Hartley's Method.**—Hartley devised, some time since, the following ingenious plan of approach to diseased glands of the neck. The operative convenience and the curative and cosmetic outcome of the plan are such as to commend its employment. The following description is quoted from Stimson's valuable work on operative surgery, and has the additional worth due to Hartley's personal revision.

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* Transactions of the American Surgical Association, vol. xiii.

*The Operation.*—"The incision is S-shaped (Fig. 1297), and involves only the skin, subcutaneous tissue, and fascia; starting below the chin it passes in a curve downward and backward to the hyoid bone, then up behind the angle of the jaw to near the lobule of the ear, whence it sweeps down along the anterior border of the trapezius, forward over the sterno-mastoid, and downward and backward again to terminate above the middle of the clavicle (*b*, *c*, *d*). The flaps thus formed are dissected up, exposing nearly the whole length of the sterno-mastoid, and the latter is cut transversely near its center and the ends reflected, care being taken not to injure the spinal accessory nerve above. The point where the muscle is divided must not be in the line of the cutaneous incision, but under the middle of one of the flaps, preferably the upper (*a*). The great vessels are thus exposed from the mastoid process to the clavicle, and the operator can excise the adherent and diseased glands, and avoid injury to the adjacent important structures.

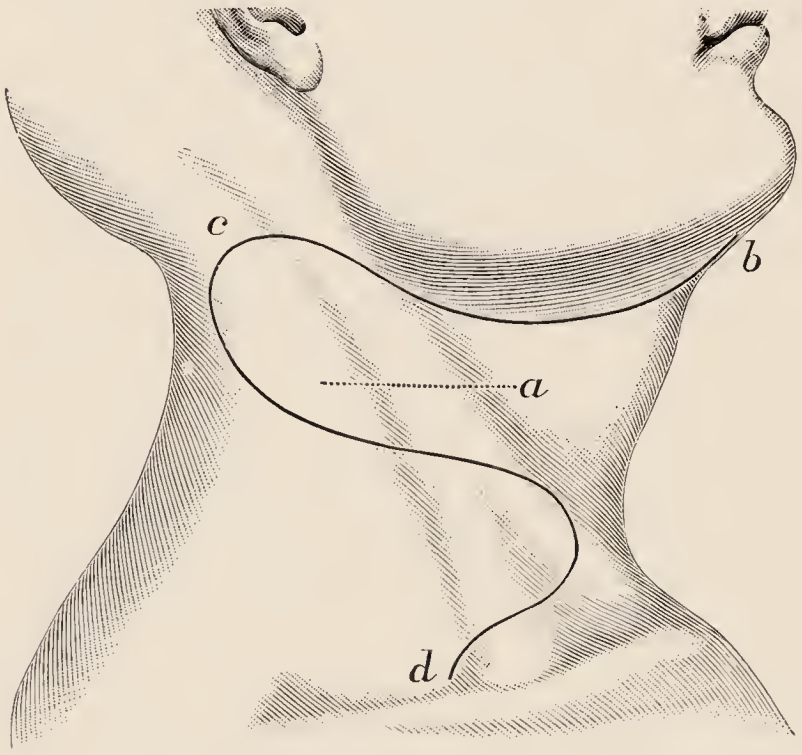



Fig. 1297.—The removal of diseased cervical lymphatic glands, Hartley's method. *a*. Point of division of the sterno-mastoid muscle. *b*, *c*, *d*. Line of incision.

At the close of the operation the divided ends of the sterno-mastoid are united with catgut, the flaps replaced and loosely sutured in position, and drainage provided for in the most dependent angles.

This large incision is only used when the glands in the superior and inferior carotid and submaxillary triangles are involved simultaneously. For less extensive disease the upper or lower flap may be employed alone; or one may be fashioned with a pedicle in a position the reverse of that shown in the figure. The incision for a single flap should approximately correspond to the circumference of the tumor, which is then exposed in its entirety by division of the sterno-mastoid below the point where it is entered by the spinal accessory nerve. The flap consists of skin, subcutaneous tissue, platysma, and fascia.

*The After-treatment.*—The after-treatment in these operations consists in securing the complete rest consistent with the proper cleanliness of the wound by an overlying plaster-of-Paris bandage, or by sand bags at either side of the head for a week or two. Fluids should be given, and movements of the lower jaw interdicted. The drainage should be removed in a day or two, except when diseased products are present. The sutures are taken out in seven or eight days; the buried ones, of course, remain.

*The Results.*—In 128 cases operated on by Billroth, 91 healed by primary union, 25 suppurated, and erysipelas developed in 5. In 49 the final result could not be obtained. In 24 per cent no recurrence appeared in three and

a half years. Local relapse happened in 14 per cent, and in 4 per cent at points distant from the seat of operation. In 16 cases the internal jugular was tied.

**Branchial Cysts.**—Branchial cysts are of congenital origin and should be removed as early in their history as practicable. Their frequent intimate association with the important deep structures of the neck invest their treatment with especial concern. Not infrequently a somewhat superficial cyst of this nature is connected deeply by means of a long, narrow, devious tract, the discovery and eradication of which is necessary to a final cure. The steps of the operative removal of these morbid developments differ in no essential respect from those directed to the treatment of diseased glands. The frequent greater profundity of the former is offset by the extensive morbid changes of the latter, so far as operative technique is concerned. The introduction of a probe along the channel to the seat of origin is often advantageous in the treatment of this variety of cases. In the instance of removal from the neck of other tumors than the special ones already considered, the rules of technique applicable to the latter can be satisfactorily applied to the removal of the former class. Briefly stated, free exposure of the growth through an incision best suited to the purpose; the removal by cautious blunt dissection, attended with prompt control of bleeding points; the prevention of air thrombosis; and the preservation of important structures.

**The Extirpation of the Parotid Gland.**—The complete removal of this gland is a most difficult operation, especially when its relations are changed by a malignant growth implicating its structure.

*The Anatomical Points.*—The space in which this gland is located is deep, narrow above, broader below, and modified by the movement of the lower jaw. It is bounded above by the zygoma; below, by a line extending from the angle of the inferior maxilla backward to the sterno-mastoid muscle; in front, by the posterior border of the ramus of the jaw; behind, by the external auditory meatus and mastoid process (Fig. 1298). The gland is separated from the submaxillary region by the stylo-maxillary ligament, and from the deeper tissues by the styloid process, and the ligaments and muscles connected with it. Prolongations of considerable size extend from its deep surface inward, one in front of and the other behind the styloid process, the former passing behind the mastoid process and sterno-mastoid muscle, the latter to the back part of the glenoid fossa. The external carotid artery passes through the gland from below upward, dividing into its terminal branches before its escape. Superficial to this artery there is a venous trunk formed by the union of the temporal and internal maxillary veins; to this trunk the internal jugular is connected by a small branch that passes through the gland structure. The facial nerve and its branches traverse the gland from behind forward, and receive a communicating branch from the great auricular in its substance. Immediately beneath the floor of the space lie the internal carotid artery and internal jugular vein, along with the spinal accessory, glosso-pharyngeal, and pneumogastric nerves. Lymphatic glands lie over the parotid and are present within it, and their enlargement may be mistaken for that of the gland itself.

*The Contraindications to Extirpation.*—Immobility of the tumor and a malignant growth implicating the structure of the gland may be regarded as strong contraindications to operation.

*The Operation.*—Place the patient upon a suitable table in a good light, with the shoulders elevated and the head turned to the opposite side. Make an incision from the zygoma downward along the central line of the tumor to its lower border. If necessary, this one can be supplemented by one or more extending from it at right angles. The integumentary flaps are freely

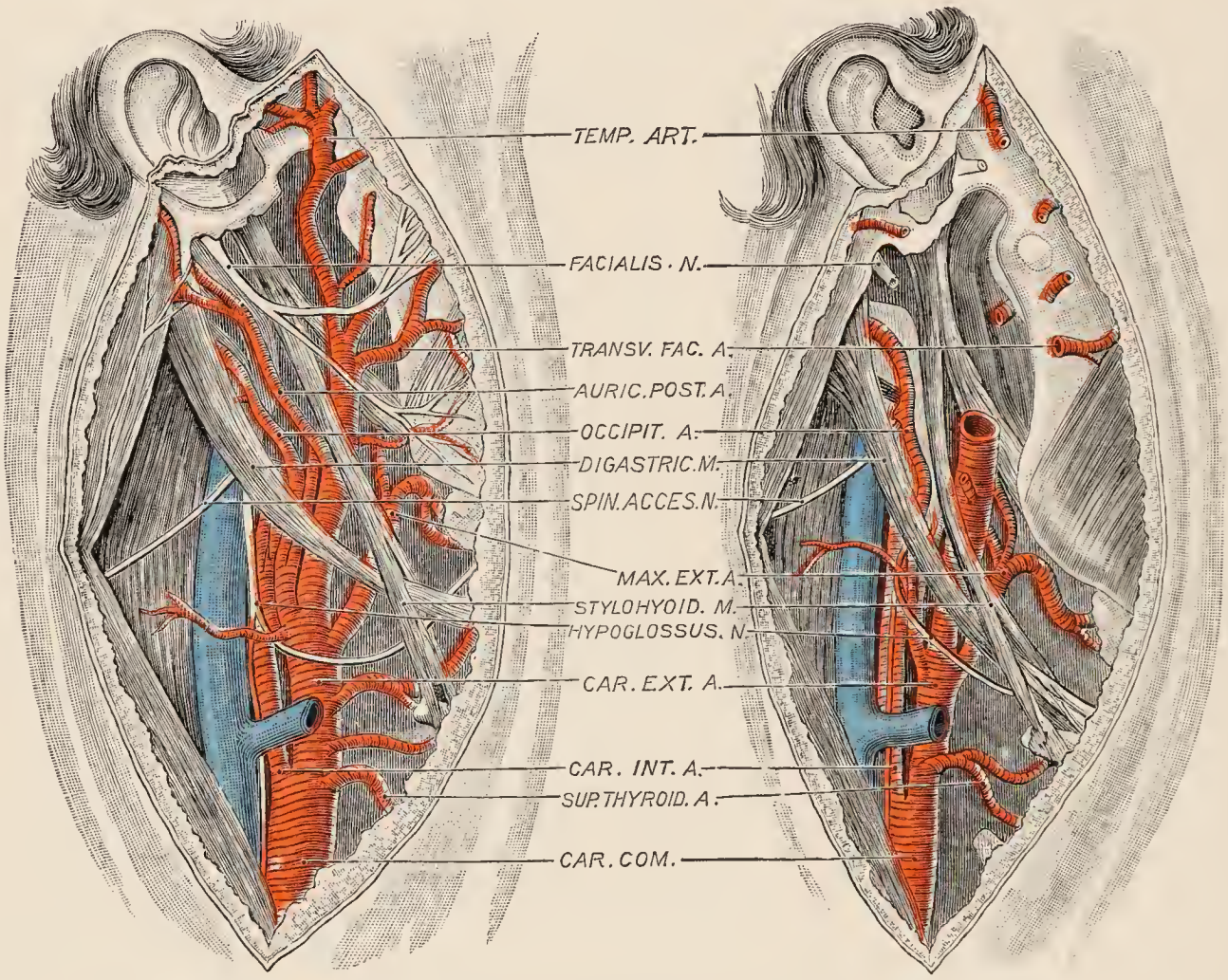



FIG. 1298.—The surgical anatomy of the thyroid gland.

reflected to expose the growth. The tumor should be raised from below upward, and held by a volsella. This will raise the external carotid from its bed, when it should be isolated, tied between two ligatures, and divided. The vessels that enter or escape from the tumor at this point should be treated in the same manner (Fig. 1298). The tumor can now be raised upward, and its separation from the deeper tissues continued by means of the fingers or handle of the scalpel; the former are the better. The vessels, as they appear in the course of the dissection, are isolated and cut between two ligatures.

The separation of the growth from the floor of the space must be done gently and with great caution on account of the contiguity of the internal jugular vein and the other important vessels, and the nerves located there, which, if the growth be a large one, will be pressed upon by it, and may have become adherent to it. It is scarcely possible to avoid division of the facial nerves if the growth be compact. If it be soft and spongy, the integrity of the nerve may be preserved by a careful use of the fingers or director. The

upper extremity of the gland is last removed. This step of the operation is necessarily attended with considerable hæmorrhage, which is, however, easily controlled. After the removal, unite the flaps, establish drainage, and dress antiseptically. During the dissection, room can be gained by causing the patient to open the mouth. Some tumors of large size, without adhesions, are more easily removed than small adherent tumors. When, as one approaches the large vessels, the adhesions become more resistant, great caution should be exercised as the important structures may be closely adherent to the tumor. If, then, further efforts to separate the tumor be unwise, the separated portion should be cut away and the remainder left in place. Often under these circumstances the remaining portion becomes with increasing growth more superficial, when it can be removed. The division of and turning aside of the ramus of the jaw has been done in some instances to gain more room. The limited space in which the gland is located leads to early adhesions at its important aspects. Preliminary ligature of the external carotid lessens the amount of the bleeding from the arteries directly concerned in the operation. Respiratory aspiration exercises its influence on the veins involved in the operation.

*The Results.*—This operation has been done upward of 200 times. When performed for malignant growths, the disease has almost invariably returned within six months. The dangers to life from the operation itself are about 12 per cent; only a few cases of cure of malignant disease are reported.

# CHAPTER XVII.

## *OPERATIONS ON THE URINARY BLADDER.*

The cavity of the bladder may be explored by catheters, by sounds (Fig. 1494), and by searchers (Fig. 1157); inspected by the cystoscope (page 1159) and through an opening above the pubes; its outer surface is examined by rectal and abdominal palpation.

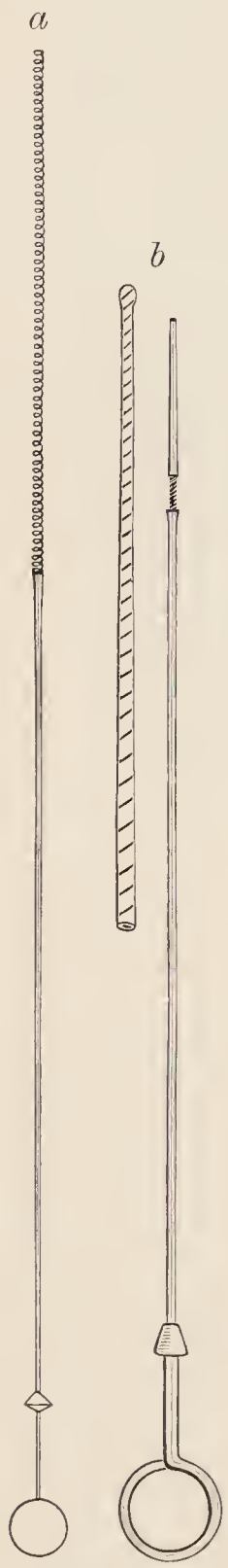



Fig. 1299.

*a*. Keyes's catheter guide. *b*. Otis's catheter guide.

The catheters can be practically divided into the soft-rubber, silk, gum-elastic, and metal varieties. The first two varieties are extremely flexible, and are harmless instruments in the clumsiest hands (Fig. 1304, *a*). It is sometimes necessary that a soft-rubber catheter be provided with a guide in order to properly direct it as well as to overcome any slight impediment in its course (Fig. 1299). The gum-elastic and metal instruments especially modified for distinct purposes will be considered later.

**The Care of Catheters and Sounds.**—Sounds and metal catheters should be maintained in a perfectly smooth and polished state, and so protected as not to be roughened or dented. These, like other instruments, should be thoroughly cleansed and sterilized before using. If before using either be dipped into alcohol and the alcohol ignited, sufficient sterilization is made to meet the purpose. Metallic instruments can be readily sterilized by passing them carefully in the flame of a Bunsen burner. Sterilized oily substances are good lubricants for the *metal* instruments, and castor oil and fluid alboline are the best examples of these substances. But soft-rubber instruments are rapidly deteriorated by oleaginous substances. *White* and *Martin* recommend the following lubricant for rubber instruments—in fact it may be used for all :

℞ Boroglyceride..... ℥ iij;
M. Aquæ destil..... f ℥ ix.

Rubber instruments are not only purified but benefited by boiling, while textile instruments, protected by varnish, soon blister and crack from the effects of heat. Special apparatus for sterilization of all varieties of urethral instruments can be procured in the supply stores of large cities. Only suitably sterilized instruments should be introduced into the urethra and bladder, and the same precautions

should characterize their use as are practiced in general operative procedures. The meatus should be wiped off with aseptic cotton saturated with a sterilized fluid before a sound or other instrument is introduced. The urethra and meatus can be thoroughly sterilized by irrigation with a permanganate solution of 1 to 5,000. Washing out the bladder is practiced by some surgeons, after the introduction into it of an instrument.



FIG. 1300.—The introduction of catheter, first step. Instrument parallel with abdomen.

*The Introduction of a Catheter or Sound into the Bladder.*—Select an instrument of a suitable curve and size; place the patient on the back, with the shoulders somewhat raised and the thighs slightly flexed on the abdomen, and rotated outward to relax the abdominal muscles; warm and smear the instrument with a properly sterilized substance; stand on the left side of the patient; grasp the penis with the middle and ring fingers of the left hand and raise it vertically. The catheter or sound is then taken lightly between the thumb, index, and middle fingers of the right hand, and introduced into the meatus held open by the left index finger and thumb. The instrument and penis should now be carried close to the body in the line of the groin, or over and parallel with abdomen (Fig. 1300); the former is the common manner. The penis is then gently drawn over the instrument, which at the same time is carefully pushed, or allowed to enter by its own weight, into the canal (Fig. 1301). After about five inches of the instrument have disappeared, the outer extremity should be carried toward the median line of the body of the patient and elevated slowly to a vertical position, when its weight will usually cause the advancing end to pass beneath



FIG. 1301.—The introduction of catheter, second step.

the pubes; after which the upper extremity is depressed between the thighs, causing the point to enter the bladder (Fig. 1302).

*The Comments.*—In passing a catheter with a stylet, hold the latter firmly in place, or the end may escape through the eye of the catheter and lacerate the urethra. Not infrequently the advancing end, as it passes beneath the arch of the pubes, will hitch upon the triangular ligament. This can be obviated by raising the point of the instrument at this situation by the finger pressed firmly against the median line of the perinæum, accompanied by upward traction on the instrument as the point is being advanced (Fig. 1303); in a word, causing the instrument to hug the roof instead of the floor of the canal. The beginner is apt to carry the handle of the instrument between the thighs too soon, causing the beak to be reversed in front of the pubes. Under no consideration must violence be employed in introducing a catheter, *ars non vis* being an almost traditional axiom in this connection. The surgeon should always follow the advancing end of the instrument with the mind's eye, aiming to keep it in the axis of the urethral curve. The first approach of the instrument to the perineal portion of the urethra not infrequently causes a contraction of the muscles of this region, which interposes an effective temporary obstacle to its advancement. If, however, the patient's attention be engaged in conversation or otherwise diverted from the procedure, while at the same time the end of the instrument is pressed continuously and carefully against the obstacle, it will soon give way and enter the bladder without further trouble. If the instrument be a catheter, the flow of urine usually announces its entrance into the bladder. If the eye of the catheter be obstructed, or a sound be used, the exact situation of the instrument may be determined by rotating it on its long axis, when, if the beak be in the viscus, its extremity will describe the



Fig. 1302.—The introduction of catheter, third step.

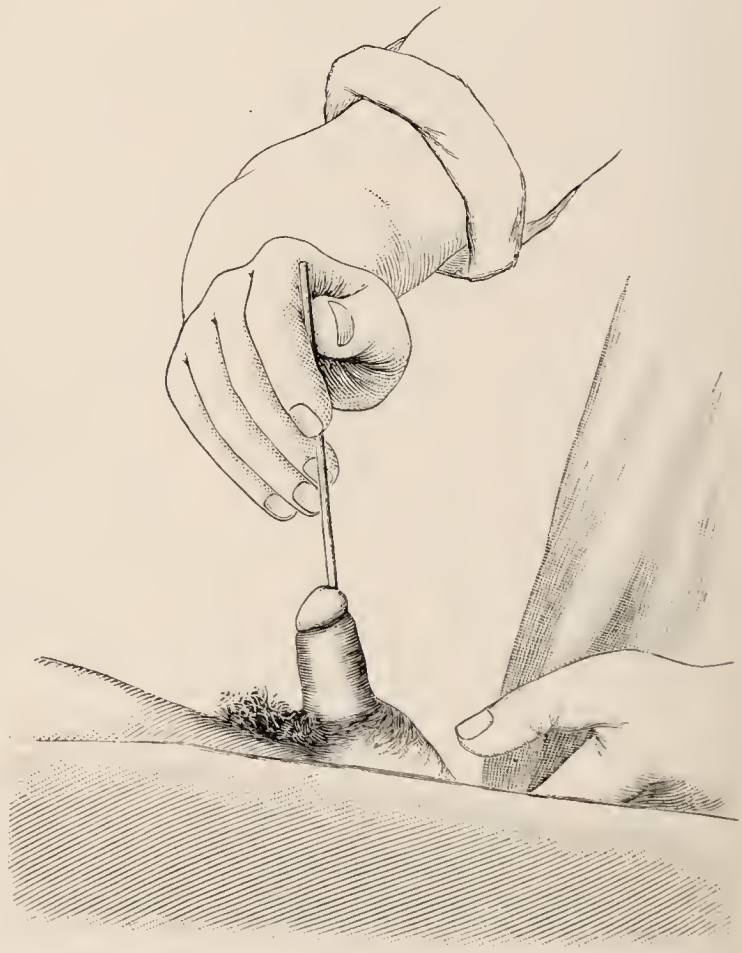


Fig. 1303.—The introduction of catheter, disengaging end of instrument from triangular ligament.

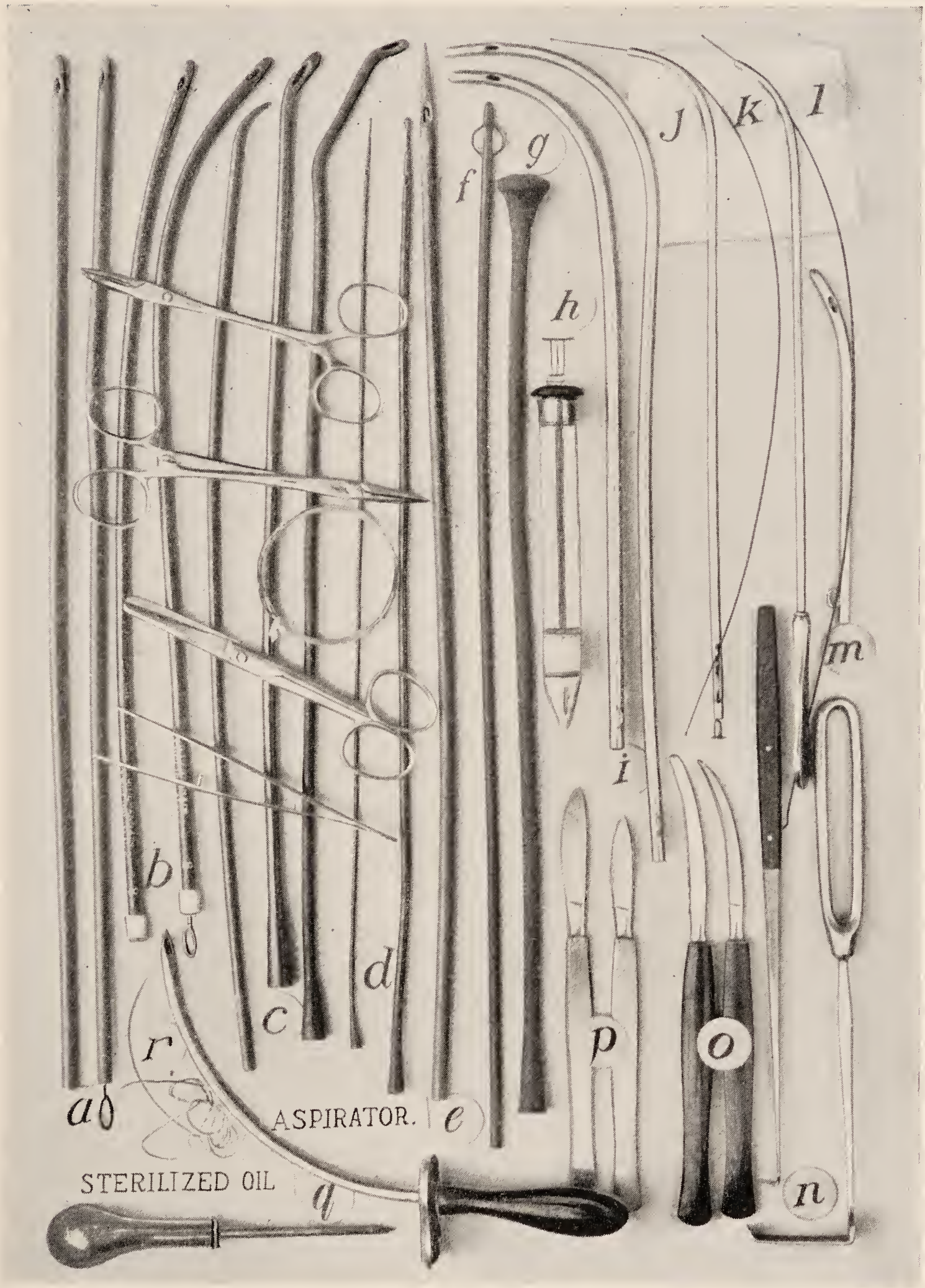



FIG. 1304.—Instruments employed in the treatment of retention of urine.

*a*. Conical soft-rubber catheters, one with stylet. *b*. Conical gum-elastic catheters, one with stylet. *c*. Flexible single- and double-elbowed catheters. *d*. Olive-pointed flexible catheters. *e*. Pointed soft-rubber catheter. *f*. Holt's self-retaining catheter. *g*. Jacobs's self-retaining catheter for bladder drainage. *h*. Small glass syringe. *i*. Ordinary and prostatic silver catheters. *j*. Tunneled catheter and whalebone guide. *k*. Tunneled sound and whalebone guide. *l*. Wiper. *m*. Female catheter. *n*. Tenaculum and blunt retractor. *o*. Curved probe- and sharp-pointed bistouries. *p*. Scalpels. *q*. Straight and curved tractors and cannulæ. *r*. Long needle and traction loops. Forcipressure, scissors, forceps, wipers, small sponges, sponge holders, abundant gauze, sutures, ligatures.

arc of a circle around its shaft as a center; if it do not, then the shaft will describe a circle around its beak. If the bladder be empty or contracted, the impingement of the beak upon its walls may not be recognized, thus deceiving the beginner and also causing the patient much pain. The introduction of the index finger into the rectum will aid in guiding the instru-

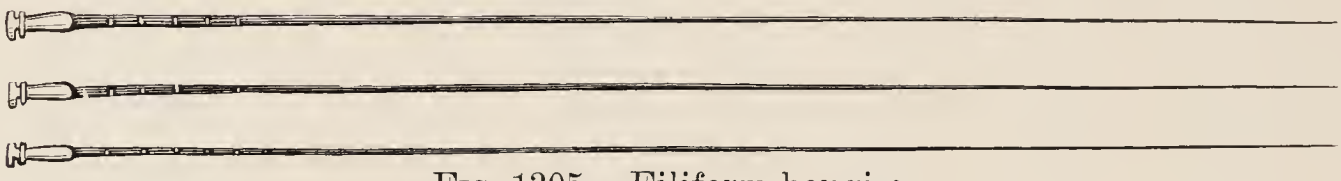


FIG. 1305.—Filiform bougies.

ment into the bladder, and determine the fact of its entrance as well. Hot fomentations to the abdomen, together with an anodyne and perhaps a ten-grain dose of quinine, may be employed if a urethral chill be feared. The injection into the urethra of a weak solution of carbolic acid and oil after the withdrawal of the instrument, and just before urination, will diminish the smarting, and is thought by some surgeons to lessen the severity and prevent urethral chills.

**Retention of Urine.**—Retention of urine depends upon some obstruction to its egress located at the neck of the bladder or in the course of the urethra; also upon paralysis of the muscular coats of the bladder, or upon all combined.

The indications are met by overcoming the obstruction or restoring tone to the bladder.

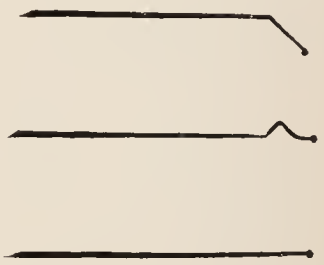


FIG. 1306.—Gouley's whalebone guides.

*The Retention from Stricture.*—If the obstruction be due to stricture, and it is permeable, catheterism will effect ready relief. If it be impossible to introduce an ordinary catheter, even of a small size, recourse must then be had to filiform bougies (Fig. 1305) or whalebone guides (Figs. 1306 and 1501). The patient is placed in the dorsal position, and sometimes local anæsthesia is employed. If general anæsthesia be necessary, it is advisable to relieve a much-distended bladder of some portion of the fluid by suprapubic aspiration (page 1116) to avoid the danger of rupture during the struggles of the patient. If one be not entirely familiar with the use of the whalebone guides and the tunneled catheter (Figs. 1307 and 1309), neither local nor general anæsthesia is advisable, as then the patient's sensations can not be consulted, and great harm might arise from their use.

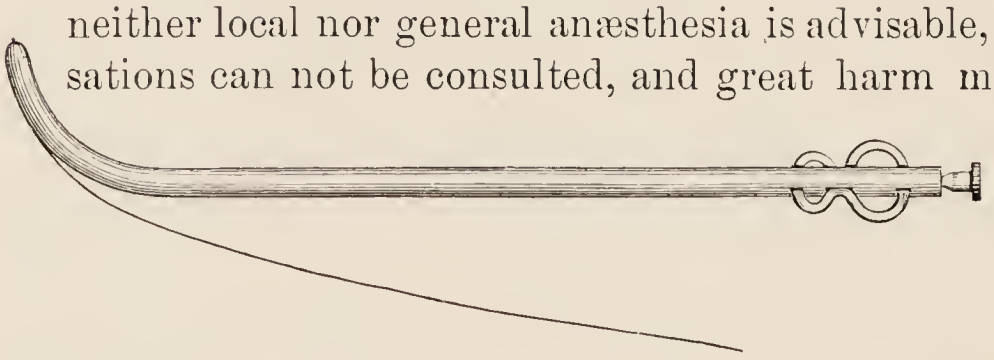


FIG. 1307.—Gouley's tunneled catheter and whalebone guide.

*The Introduction of Whalebone Guides.*—After cleansing the meatus and glans (page 1109), the urethra is forcibly filled with sterilized oil by means of a syringe (Fig. 1304, *h*), and the end of the penis grasped to retain the fluid, leaving sufficient room at the meatus for the introduction of the whalebone guide. A guide is carefully introduced, and if its point becomes engaged in a lacuna (Fig. 1308, *c*), it is withdrawn a little and again carried onward with

a rotary motion. If it enter a false passage, or is arrested by a stricture, it is allowed to remain there, while another guide is passed by its side, and so on until four or six, or even more, are contained in the canal (*c*), some of which have the spiral and others the straight or elbowed end foremost. Each one is then taken separately and pressed onward, with or without the rotatory motion, always remembering to use no force, else the small points may pierce the mucous membrane of the urethra, or enter and perforate Cowper's ducts. As soon as all the side openings are closed by the extremities of the guides, one guide will be found to have entered the stricture (*c*), and, with a little coaxing, will pass into the bladder, which is known by the painless ease with which it can be moved in and out. The others are then withdrawn, and the end of the one remaining is passed through the eye of a tunneled sound (Figs. 1304, *k*, and 1309), or, what is better, the tunneled catheter (Figs. 1307 and 1304, *j*). The guide serves to direct the passage of the instrument into the bladder, which should be done cautiously, as the guide may be cut by the eye of the instrument, causing it to double and direct the end of the catheter astray. When the instrument is in the bladder urine flows freely, and the beak can be turned from side to side around the long axis of the stem. After the requisite amount of urine is withdrawn, a tunneled sound of larger size may be passed in a similar manner as the tunneled catheter, after which the guide can be taken out and an ordinary steel sound of proper size carefully introduced to insure a channel of sufficient capacity to admit the ready entrance of an instrument thereafter.

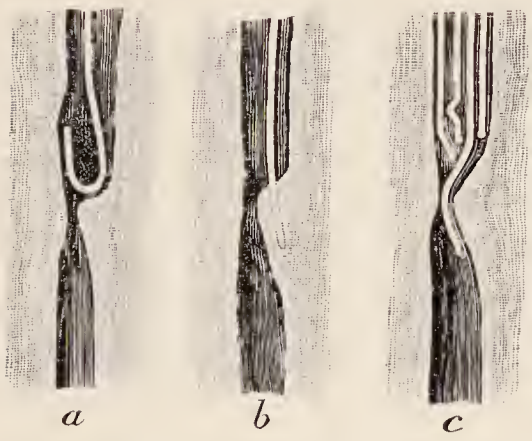



FIG. 1308.—The introduction of whalebone guides. *a*. Guide bent upward. *b*. Guide in lacuna. *c*. Numerous guides in urethra, one passing stricture.

*The Comments.*—A whalebone guide may bend, turn upon itself (Fig. 1308, *a*), and become arrested. It is important to know that the bladder should not be entirely emptied of its contents, but that only a sufficient amount of urine should be drawn to afford complete relief from all pain and tension. If it be completely emptied, its walls will collapse from want of support, causing congestion of the lining, and in all probability the catheter will be required at one or more succeeding attempts at urination. But if a



FIG. 1309.—Gouley's tunneled sound and whalebone guide.

third or a half of the contents be withdrawn, the bladder is likely to expel its contents properly when the occasion next requires. A failure to enter the bladder finally calls for perineal section (page 1249).

*Retention from Enlarged Prostate.*—In retention from this cause prompt relief should not be limited by palliative procrastination. In the majority of instances the invaginated (Fig. 1500) single- or double-elbowed flexible catheter (Fig. 1304, *c*) can be quite readily passed; failing with this, the introduction of the soft-rubber instrument, with the ordinary stylet (Fig. 1304, *a*) to maintain the needed form and rigidity, can be tried at different curves. The silver prostate catheters (Fig. 1304, *i*) and the malleable one of block tin can be employed, but always with infinite care. The form of the latter can be easily changed by bending to meet the demands of a devious entrance to the bladder, and has repeatedly been used by the writer with gratifying results. However, its liability to bend and break when used with unwise manipulative force should be recognized and heeded. In rare instances the whalebone guide and long curved tunneled catheter may solve the difficulty, but the danger from their immoderate use is not to be

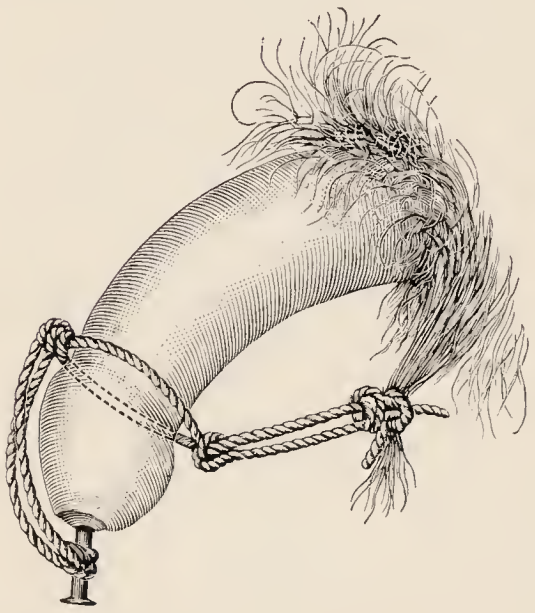
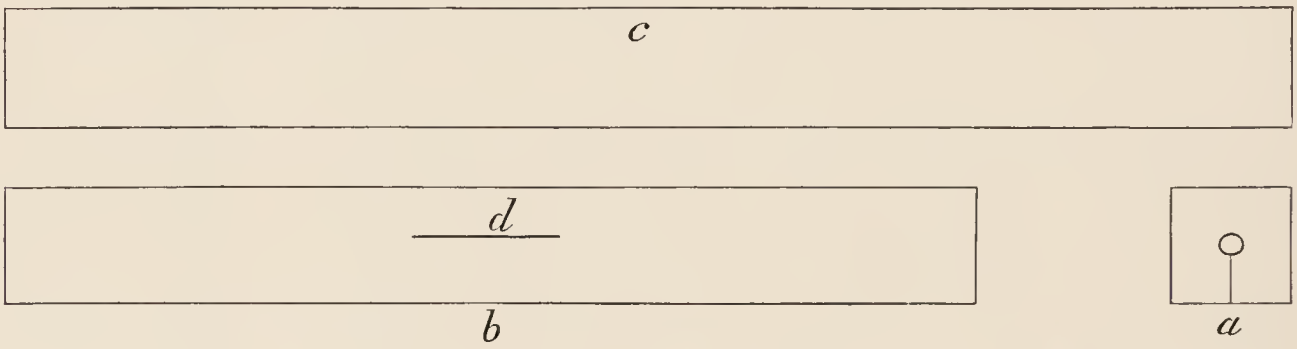


FIG. 1310.—The temporary fastening in place of a flexible catheter.



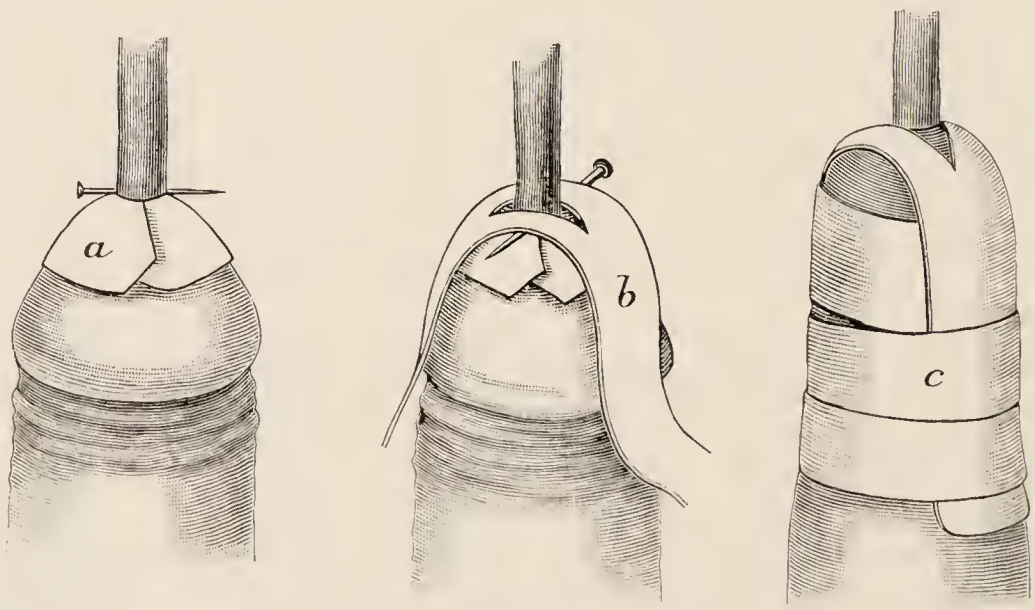




FIG. 1311.—The fastening of a catheter in place, Dittel's method. *a*. Adhesive plaster collar. *b*. Retention plaster holding pin. *c*. Strip binding others in position.

underestimated. The too pointed extremity and improper curve of the latter unfit it for common use. The length of time employed in these manipula-

tions should be limited to ten or fifteen minutes, and the vigor of the effort should be of a conservative character. At the best, some bleeding will follow in many instances, regardless of the instrument employed. If entrance to the bladder be gained only after considerable difficulty, the catheter should be fastened in place by one of several methods (Fig. 1310) and permitted to remain for a time, and, if withdrawn, be quickly followed by a flexible one, which is permitted to remain at least for forty-eight hours undisturbed. Continuous catheterism can be practiced for two or three weeks if frequent cleansing of the urethra and the catheter be employed (Fig. 1311). The tape holding the instrument in place may be pinned to a bandage passed around the body. If the surgeon fail to enter the bladder, he should then resort to suprapubic aspiration, or puncture, or to perineal section.

**Puncturing of the Bladder.**—Puncturing the bladder is done to relieve the organ from overdistention. The puncture can be made either above or below the pubes, and through the rectum. It may be performed by direct incision with the ordinary curved trocar, and by aspiration, the latter being the safer and often the more satisfactory way.

*The Anatomical Points.*—The anatomical points are considered under Suprapubic Lithotomy (page 1197).

**Suprapubic Puncture.**—"Suprapubic puncture is the operation of choice," says Alexander, "in cases of retention due to enlarged prostate in which catheterization is impossible. It may also be advantageously employed in cases of retention due to old induration from stricture, especially when the latter is of traumatic origin and associated with false passages, and in which catheterization is impossible. In such cases the choice must be made between perineal section without a guide and suprapubic puncture combined with retrograde catheterization, to be at once followed by perineal section."

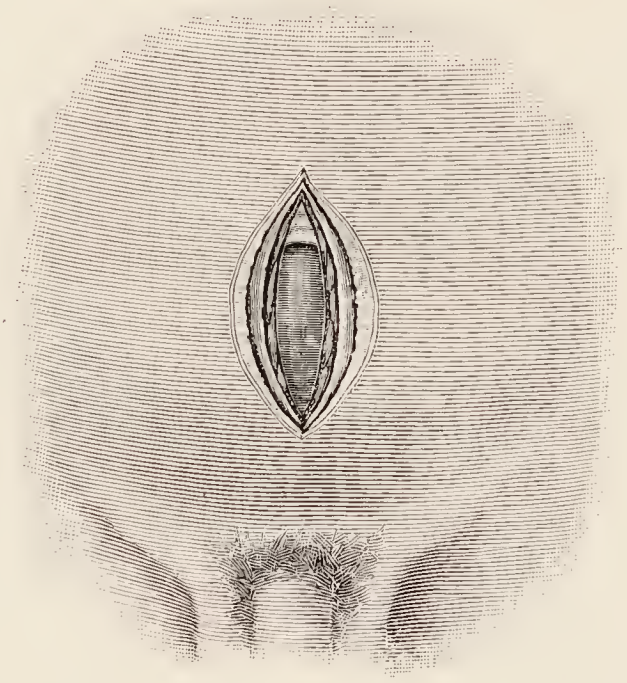


FIG. 1312.—The operation by suprapubic incision. The peritoneal reflexion seen at the upper angle of the incision.

*The Operation by Direct Incision (Suprapubic Cystotomy).*—As Alexander truly says, "The operation may be performed under local cocain anæsthesia in cases where a general anæsthetic is inadvisable. The pubis is shaved and the skin scrubbed and disinfected. An incision about an inch and a half long is made in the middle line, beginning at the symphysis pubis (Fig. 1312). The skin and fasciæ are divided down to the linea alba. The rectus muscles are carefully separated and held apart by small retractors. If the bladder be distended, the perivesical fascia and fat will appear at the bottom of the wound. They are divided and drawn to the upper part of the wound, and a round, sharp bistoury is then plunged into the bladder at the lowest part of the anterior wall, and an incision large enough to admit a 25 F.

catheter is made as the knife is withdrawn. The catheter is then introduced and fixed in place, and the wound closed up to the catheter."

*The Operation by Aspiration.*—The contents of the bladder can be removed by aspiration by introducing the aspirating needle into the organ above the pubes at the point indicated for the passage of a trocar (Fig. 1313). This, however, is a temporary measure only. The same can be said of tapping per rectum. These expedients are important, as they enable the surgeon to gain time for the performance of external perineal urethrotomy or otherwise to afford relief. If aspiration be practiced with aseptic precautions, it may be performed two or three times daily for quite as many weeks in cases not afflicted with pronounced cystitis with no unfavorable outcome. The suction force should be continued during the withdrawal of the needle to prevent urine from infecting the line of puncture at that time.

*The Operation with a Trocar.*—After thorough preparation, as in the preceding instances, place the patient on the back; outline the distended bladder by percussion; explore the tumor with a hypodermic needle if a doubt exists as to its nature (Fig. 1313). Select a small straight or curved trocar, the latter being the better; make the skin tense at a point about an inch above the pubis, and push the trocar through the median line with its convexity upward. An initiatory incision through the skin is often made with a sharp knife, which permits the easier entrance of the trocar. A preliminary injection of cocain may relieve the patient of the pain caused by the introduction of the trocar.



FIG. 1313.—Suprapubic puncture of the bladder with trocar, the fingers indicating seat of puncture. Eye of cannula is indicated.

**Puncture under the Pubes.**—If the bladder be small and shrunken behind the pubes, or the prostate be too large to admit of the rectal puncture, the penis can be pulled downward, and a small, curved trocar, with the concavity upward, passed just beneath the arch of the pubis into the viscus.

**Puncture through the Rectum.**—In puncturing by this route it is important to empty the lower bowel and thoroughly cleanse the rectum; place the patient in the lithotomy position, and introduce the left index finger into the rectum; locate the vesiculæ seminales and base of the prostate; place the end of the finger between the former, allowing it to rest upon the

base of the prostate; carry along the palmar surface of the finger a curved trocar, and push into the bladder just above the base of the prostate; withdraw the trocar, leaving the cannula in place, tying it in position, or substituting a soft catheter passed through the cannula before removal.

The almost universal practice of employing aspiration, and the superiority of this method over that of the trocar, has quite consigned the latter, along with rectal puncture, to an honorable remembrance only.

*The Remarks.*—Puncture of the bladder is performed to relieve the organ from overdistention when for any reason external perineal urethrotomy is impossible or not immediately desirable. Puncture above the pubes is devoid of operative danger unless a mistake is made in the diagnosis. The escape of urine should be regulated the same as in catheterism, when practicable, and for a similar (page 1113) reason. Sometimes the relief of overdistention will permit later the introduction of a catheter through the proper channel.

**Rupture of the Bladder.**—Rupture of the bladder may be either extraperitoneal (15 per cent) or intraperitoneal (85 per cent). Rupture occurs most frequently at the posterior surface, the urine escaping into the peritoneal cavity causing peritonitis. When the rupture occurs anteriorly the urine infiltrates the tissues of the walls of the abdomen and perinæum, causing extensive cellulitis and diffuse suppuration. The history of injury, the presence of bloody urine, and the failure to recover by catheterism a definite amount of injected sterile fluid are among the decisive symptoms of rupture.

*If the rupture be intraperitoneal*, the abdomen should be opened in the median line upward from the pubes six or eight inches, the intestines held aside with sterile pads, and the vesical opening sought for. When found, it can be satisfactorily closed by either Cushing's (Fig. 785), Halsted's (Fig. 792), or the Czerny-Lembert (Fig. 788) suture in the same manner as for intestinal wounds. Purse-string sutures are employed (Fig. 1412). The blood clots and urine are then carefully removed from the peritoneal cavity by sponging and irrigation with hot normal saline solution. A moderate distention of the bladder with aseptic fluid will test the integrity of the sewing. If the opening be not disclosed by inspection through the abdominal incision, the leakage following the injection into the bladder of a moderate amount of saline or of Thiersch's fluid will reveal the site of rupture. Careful cleansing and drainage, etc., attended with continuous catheterism for several days, and confinement in bed, are demanded. If the wound be large, irregular, and lacerated, the line of sewing is less secure, and the demand for drainage is the more positive and prolonged.

*If the Rupture be Extraperitoneal.*—The presence of an extraperitoneal rupture may be told by the area of abdominal extravasation before operation, or be determined only after the performance of laparotomy. In either case the seat of rupture is established through a suprapubic opening in the bladder, and further exposed by properly directed external incisions. The opening is closed as before, and the wound thoroughly drained with gauze. The sewing in cases of extravasation from rupture is comparatively insecure on account of the absence of the serosa and the presence of established infec-

tion. The abdominal wound is closed up to the point of leaving ample room for the escape from the prevesical space of drainage agents just above the pubis.

*The Remarks.*—The introduction into the rectum of the finger, followed by pressure upward against the base of the bladder during injection of the test fluid, will enable the surgeon to estimate correctly the degree of vesical distention attending the act. The rupture is usually located posteriorly midway between the summit and base of the organ. If the rupture be low down, the use of the inflated rectal bag will bring the parts under better command. Division of the parietal peritonæum at either side of the bladder (MacCormac) may be needed to effect the proper exposure. *MacCormac* advises catheterism at suitable intervals with a soft-rubber instrument in lieu of the continuous plan of treatment. The injection of air or hydrogen gas into the bladder for diagnostic purposes is practiced much less than that of water. In other respects there is comparatively little to express in favor of their use. If the rupture be small and inflammation around it have already taken place, the fluid may not escape into the peritoneal cavity at first, requiring repeated and often large injections for the purpose. Free manipulation of the bladder through the rectum with the finger, or pressure upon it by a distended Barnes dilator, may develop the presence of rupture. The writer once met with a case with limited extravasation so incased by adhesions behind the bladder that when distended it resembled the outlines of an uninjured organ. The opening was small, and no doubt the end of the catheter conveying the fluid passed into it. If one be satisfied that no infection remains in the peritoneal cavity, the abdominal wound may be closed at once; if otherwise, suitable drainage should be provided. If the rupture be near the base, the need of the frequent and possibly continual use of the catheter for a few days is emphasized. In prevesical rupture free drainage of the bladder and of the infiltrated tissues should be had. Continuous drainage of the bladder by a catheter should be superseded by suprapubic siphon drainage (page 1125 *et seq.*), or drainage by a perineal cystotomy in case of doubtful efficiency or the occurrence of complicating objections.

*The Results.*—If the operation be done promptly, and the urine be sterile, the prognosis is good. If the case be delayed, or the urine be infective, the prognosis is correspondingly bad.

The death rate from intraperitoneal rupture with operation is about 40 per cent, in the extraperitoneal about 38 per cent. During the last fifteen years the death rate has been reduced fully 50 per cent.

**Cystotomy.**—Cystotomy consists in opening the bladder through the perinæum usually, or above the pubes. These operations are called respectively perineal cystotomy and suprapubic cystotomy. It is practiced not infrequently for the relief of obstruction due to enlarged prostate, for inveterate cystitis, and to afford digital examination and ocular inspection of the cavity of the bladder, and for the removal of morbid formations.

*Perineal Cystotomy.*—Perineal cystotomy consists in opening into the bladder through the median line of the perinæum, as in the median operation for stone (page 1192).

*The anatomical points* are noted under Lithotomy (page 1182).

*The Operation.*—Place the patient on the back, evacuate the rectum, introduce a grooved staff into the bladder, and with a sharp knife make an incision in the median line about two inches in length, terminating about half an inch in front of the anus; by repeated and successively shortened applications of the knife—carefully avoiding the bulb—the staff is reached, and the membranous urethra opened backward to the apex of the prostate. Introduce a small probe into the bladder by way of the groove in the staff, withdraw the staff cautiously, carefully introduce the index finger into the bladder along the probe as a guide, and distend the neck of the bladder sufficiently to cause the urine to escape as fast as it flows into the bladder. The prostatic structure must be well dilated, else it will soon return to its normal condition and require a repetition of the dilating process. The prostate may be incised on either one or both sides, as in lateral and bilateral lithotomy, to maintain the patency of the opening for any length of time. Cystotomy is now quite frequently performed as an ultimate expedient in obstinate cystitis in both sexes. In the female the incision is made into the bladder through the vagina.

*Suprapubic Cystotomy.*—The bladder is opened above the pubis by a transverse (Fig. 963) or vertical incision (usually the latter) for various purposes, notably for removal of stone and prostatectomy (page 1131).

*The Results.*—The operation of cystotomy alone implies but little danger to the patient. However, when done in the presence of disease of the bladder or kidneys, the final outlook is much less promising, and can be well judged by the results in operation for these conditions respectively.

**Cystotomy for Tumors.**—Tumors can be removed from the bladder by the perineal or the suprapubic route. The *perineal route* is the better one when the growth is near to the vesical orifice, especially if the perinæum be not deep and complicated by enlarged prostate. Even in such cases as these the advantage gained by dependent drainage can not be underestimated, since it lessens the death rate, promotes the comfort, and contributes to the recovery of the patient. After cystotomy is performed and the neck of the bladder is dilated, forceps with serrated blades and distinctive curves (Fig. 1314, *i*, *j*, *k*, *l*) are introduced into the bladder, opened, the tumor seized and twisted away—not pulled, as forcible traction is highly objectionable. Repeated applications of the forceps, directed by the finger in the bladder, are made until the tumor is finally removed. Unusual bleeding is controlled by hot-water irrigation, direct pressure, etc. Suitable drainage of the bladder (Fig. 1123) should follow the operation for some days, after which the urine is permitted to resume the natural channel. *Gouley*, *Chismore*, and others have removed polypoid growths through the urethra by means of a lithotrite.

*The Comments.*—Suprapubic pressure to secure control of the tumor may cause the forceps to seize the bladder walls with obvious outcome. Polypoid growths of all kinds can thus promptly be removed, but sessile ones of extensive growth are not amenable to this treatment.

*The suprapubic route* for the removal of vesical tumors affords the opportunity of good observation, intelligent manipulation, and scientific tech-

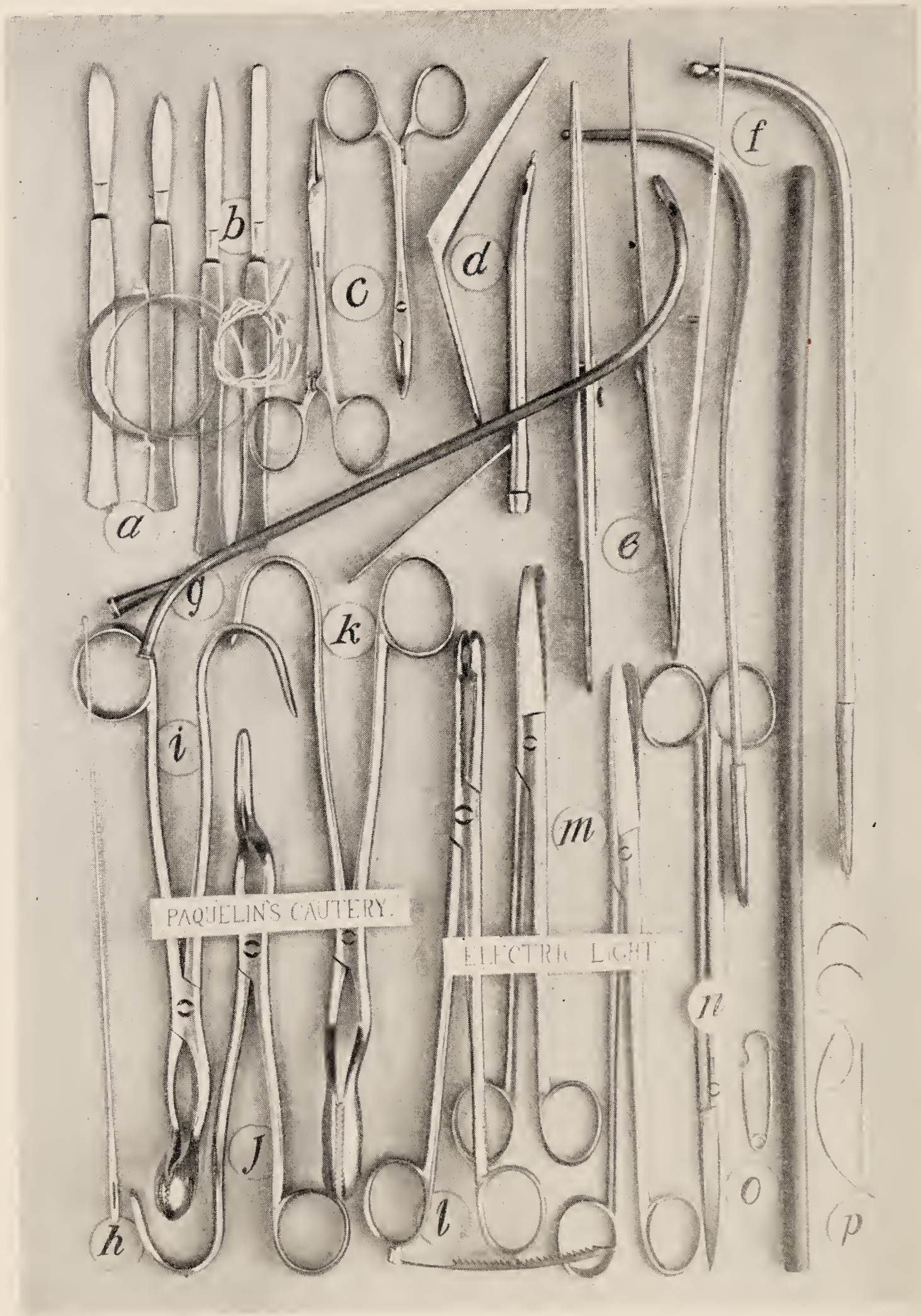



FIG. 1314.—Instruments employed in cystotomy and treatment of tumors of the bladder.

*a*, Scalpels. *b*. Bistouries. *c*. Forcipressure. *d*. Teale's gorget and Brown's grooved catheter director for primary incision. *e*. Long forceps. *f*. Grooved staffs. *g*. Double-current catheter. *h*. Long silver probe. *i*, *j*, *k*. Thompson's tumor forceps. *l*. Wyeth's forceps. *m*, *n*. Long, straight, blunt-pointed, and curved blunt- and sharp-pointed scissors. *o*. Safety pin and perineal drainage tube. *p*. Assorted needles. A female silver catheter, elbowed and straight rubber catheters, scoops, rongeur, blunt and hooked retractors, sponge holders, tenaculum, wipers, ligatures, traction loops, and tampons should be at hand.

nique. The anatomical points are stated under Suprapubic Lithotomy (page 1197).

*The Operation.*—After thorough cleansing of the abdominal wall, perinæum, mucous and cutaneous surfaces of the genitals, and of the bladder and rectum, place the patient on the back with the hips and shoulders raised to relax the abdominal wall; introduce the rectal bag (Figs. 1407, 1408, and 1409) above the sphincters, and distend it with six or eight ounces of fluid; inject into the bladder eight or ten ounces in the adult, and in the child about half of this amount; make an incision from the pubis upward in the median line three or four inches in length; separate the tissues in the median line, going through the fascia that bounds the prevesical space in front, exposing the prevesical fat; pass the finger behind the pubis, hook up and draw upward the prevesical fat along with the peritonæum, thus exposing the bladder; draw apart the borders of the wound with retractors or traction sutures; flush the field of operation with a five-per-cent solution of carbolic acid, or smear it with iodoformized vaseline to prevent infection; introduce at each side of the median line of the bladder, through the muscular coat in front, a traction suture; thrust through the bladder in the median line, half an inch below the upper border of the pubis, a bistoury, and cut upward sufficiently to admit the index finger; introduce traction sutures through each border of the wound of the bladder, and draw the bladder open as the incision is extended upward, duplicating the sutures if need be, or use retractors instead; place the patient in Trendelenburg's position (Fig. 55) and remove the rectal bag; cleanse the bladder by irrigation and sponges, and proceed to inspect the cavity with the electric light; incise the bladder transversely if additional room be needed. After exposure the growth is removed by forceps (Fig. 1314), cutting, cautery excision, etc., as seems to best suit the demands of the case.

*The Remarks.*—Tearing of the tissues should be carefully avoided. The muscular fibers should be separated and fascia divided, not torn. Bleeding points are promptly secured throughout the operation, and anticipated by clamping before division, when feasible. It is wiser to carefully divide the prevesical fascia after drawing up the peritoneal fold than to tear it asunder, as then infiltration and sloughing are encouraged. In lieu of the traction suture a tenaculum can be inserted transversely into the wall of the bladder in the median line just below the peritoneal fold (Figs. 1312 and 1408, *a*), or at the seat of the upper limit of the proposed incision, which when drawn upward supports the wall of the bladder and protects the peritonæum from injury at the same time. The incision into the bladder should be made away from avoidable vessels, and the mucous membrane quickly divided, otherwise it may be pushed off the bladder wall and remain uncut. The finger is not introduced until the borders of the bladder wound are under the control of silk loops or of forceps, unless it be done to hook the bladder forward and hold it while the other restraining influences are being applied. The borders of the wound should be carefully treated in every instance. It may be advisable in rare instances in disease of the bladder to sew the lips of the visceral wound to those of the abdominal incision.

*Trendelenburg* advises that a slightly convex transverse incision four inches long be made above the pubis (Fig. 963) with the convexity downward, in cases where the bladder is small and distensible. The prevesical space and the bladder are opened through this incision without risk of damaging the integrity of the peritonæum.

*Langenbeck* proposed a subpubic route through an inverted ⅄-shaped incision (Fig. 963), the arms of which correspond to the course of the rami of the pubis.

*Helferich* proposed a subperiosteal resection of the pubis through a transverse incision made along its upper border, to render the bladder more accessible. Symphysiotomy has been proposed for the same purpose.

*Infiltrating tumors* of the wall of the bladder are readily treated, unless they implicate the base of the organ and its important associations. *If the tumor* involve the muscular coat only, the peritonæum corresponding to the growth is dissected off and away from the tumor, the tumor removed, and the muscular wound closed with sutures, without involvement of the peritoneal cavity. If the peritonæum be involved, then the entire thickness of the wall must be removed, which is done best by the use of a clamp and through and through sewing with catgut, if the physical aspects of the tumor will permit of such a course. The implication of the ureteral region of the bladder has a much more serious aspect, not only on account of the ureters themselves, and the necessity of disposing of their discharges, but also of the greater difficulty of repair, and the contiguity of important structures. However, the base of the bladder, and, in fact, the entire organ has been removed successfully (page 1156). So far as the final disposition of the ureters is concerned, *Clado*, according to White and Martin, adopts the following conclusions: "Leaving the ureter open in the wound after extirpation of a neoplasm is extremely dangerous. Implantation into the rectum is almost invariably fatal. Implantation into the colon (page 862 *et seq.*) is more successful. Implantation into the parietal wound (page 866) is sometimes a matter of necessity. Implantation into the vesical cavity (page 859) and anastomosis with the ureter of the opposite side (page 866) are the two operations which give the greatest promise of a definite recovery."

*Albarran* summarizes the general treatment of malignant tumors of the bladder as follows: "The patient should be placed in the Trendelenburg position and the neoplasm subjected to an examination. If the tumor is sessile, if no enlarged lymph nodes are found, and if the patient is in good condition, resection of the bladder wall is indicated. This resection is easily performed if the tumor is placed above the opening of the ureters, since it is then unusually accessible, enough room being secured by incision through the attachments of the recti muscles. When the tumor is placed posteriorly in a bladder which is naturally deep seated, or above the ureteral orifice, or behind the anterior wall of the bladder marked by the pubic symphysis, partial resection of the symphysis or symphysiotomy may be required. Resection of the tumor is easiest when it is situated upon the upper portion of the bladder where the peritonæum can be readily stripped back. After this stripping, the tumor, with a portion of the healthy bladder wall, is cut

away with scissors and the wound is sutured. If the tumor is placed above the ureters posteriorly it may be circumscribed by an incision through the mucous membrane and resected from within outward, no effort being made to strip the peritonæum first. If the tumor is placed about the orifice of the ureter, the latter should be catheterized, should then be exposed by cutting through the lateral wall of the bladder, and should be freed and implanted into the healthy wall of the viscus. If this operation is impossible, the wound made through the bladder wall for the purpose of exposing the ureter should be closed, and the urine escaping through the ureteral catheter should be examined carefully. If the urine is clear, showing that the kidney is not infected, the catheter should be withdrawn and the ureter should be ligated, divided below the ligature, and suitably implanted (page 859 *et seq.*). If the urine escaping through the catheter is turbid, showing admixture of pus, the ureter should be divided and fixed to the abdominal wound. Whatever procedure is employed for the purpose of giving more room, the bladder should be closed completely, a permanent catheter should be introduced, and the prevesical space should be packed with iodoform gauze. Total resection of the bladder is indicated only in the case of multiple epitheliomata which have not yet extended beyond the muscular wall."

After removal of the tumor, arrest the hæmorrhage and drain the bladder through the suprapubic opening, through the urethra, or by perineal urethrotomy. Chromicized catgut sutures carried down to but not through the mucous membrane, and placed about a quarter of an inch apart, should be employed, so as to hug closely the drainage tubes (page 1126). Close the abdominal wound with silkworm-gut sutures, leaving a point at the lower end unclosed, through which a strip of gauze is passed to drain the prevesical space. The epipubic notch is a sure guide to the median line below, and can be located through a small incision of the superficial tissues in all cases.

*The Precautions.*—The prevesical adipose tissue should be treated kindly to prevent suppuration, urinary infiltration, etc. The author has practiced a free smearing of the wound with iodoformized vaseline in such cases with satisfactory results. Glandular enlargement contraindicates extensive operation on the bladder for removal of malignant disease. When the urine is sterile, the bladder healthy, the wound small and closed completely, permanent closure of the vesical and abdominal wounds with continuous catheterism are indicated. If the reverse be present drainage should be provided at the seat of the wound. In all instances careful scrutiny should be exercised to detect urinary infiltration and forestall its evil effects.

*The Results.*—*Butlin* reports 57 cases of partial cystectomy with 16 deaths; 10 of complete, with 4 recoveries; more fatal in men than women (page 1156).

**Drainage of the Bladder.**—The bladder may be drained after operation, in three ways: First, by a catheter passed through the urethra and retained there; second, by a tube introduced through the perinæum; third, by a tube or tubes introduced through the suprapubic wound.

*Vesical Drainage per Urethram.*—This method of drainage is only applicable in cases in which drainage is required for a short time. It is

rarely that the catheter can be retained more than three or four days without causing more or less serious inconvenience. Many patients can not tolerate the presence of the retained catheter. This method may be used to advantage in such cases as amputation of the penis and in certain cases of enlarged prostate in old men who have become accustomed to catheter life. In these latter cases it is sometimes useful, when the calls to micturate are frequent, to introduce a tie in or a clamp catheter at night, thereby giving the patient a chance to sleep. To be effective, the retained catheter must be carefully and accurately adjusted, and fastened securely so as to prevent slipping.

A soft-rubber catheter, size No. 12 F., with velvet eye situated as near the extremity as possible, and without a *cul-de-sac*, is sterilized by boiling, and is introduced so that the eye is just within the bladder. If the catheter is too far in the bladder it is certain to cause painful vesical contraction; if it is not introduced far enough the urine will not flow through it. If the bladder be emptied by a catheter and a boric-acid solution be substituted for the urine, and the catheter, while being slowly withdrawn, is arrested and fastened just before the fluid ceases to flow, it will be suitably located. With aseptic care continuous catheterism may be kept up from one to three weeks with comparative comfort and no danger. However, if urethritis arise, causing much infliction, drainage of another form should be substituted. At first relief may be afforded in these cases by flushing the anterior urethra with a warm boric-acid solution. After accurate adjustment, the catheter is properly secured (Fig. 1311), and the end of the catheter or a rubber tube attachment is submerged in a bottle or urinal, containing an antiseptic solution, placed between the patient's thighs as he lies in bed. When this method of drainage is used the catheter should be changed daily and replaced by a new one, or, if the same catheter be used again it should be resterilized by boiling. Whenever catheter drainage is used the bladder should be washed out at least once a day with a hot sterile borax solution.

**Perineal Drainage.**—Perineal drainage may be employed after all operations upon the bladder, prostate, and deep urethra, or in cases of severe cystitis in which it is desirable to give the bladder rest. The membranous portion of the urethra having been opened through the perinæum, the finger is introduced through the prostatic urethra into the bladder. The stretching of the prostatic urethra by the finger greatly lessens the pain felt at the end of the penis experienced by cases where the drainage tube is retained. A rubber catheter, size No. 26 to 30 F., with a large eye near the end, and without a *cul-de-sac*, and with a wide lumen, is introduced into the bladder and adjusted so that the eye is just within the bladder; the adjustment should be made with the patient's thighs on the same plane as the body. The instrument is secured in place by tapes which are tied about it as near to the perineal wound as possible, and are then brought up and secured to a waistband. A dressing of gauze pads, perforated to admit passage of the catheter, is made and secured by a T bandage. After the patient is in bed the end of the catheter is connected to a long piece of rubber tubing having a glass funnel at its extremity, and the tube and funnel having been filled with water, the latter is sunk in

a vessel placed on the floor under the bed, or in it (Fig. 1315), and containing a solution of bichloride, 1 to 2,000.

The bladder can be washed out as often as necessary by disconnecting the siphon tube and injecting the fluid carefully through the catheter by means of a Politzer's bag or a carefully adjusted syringe.

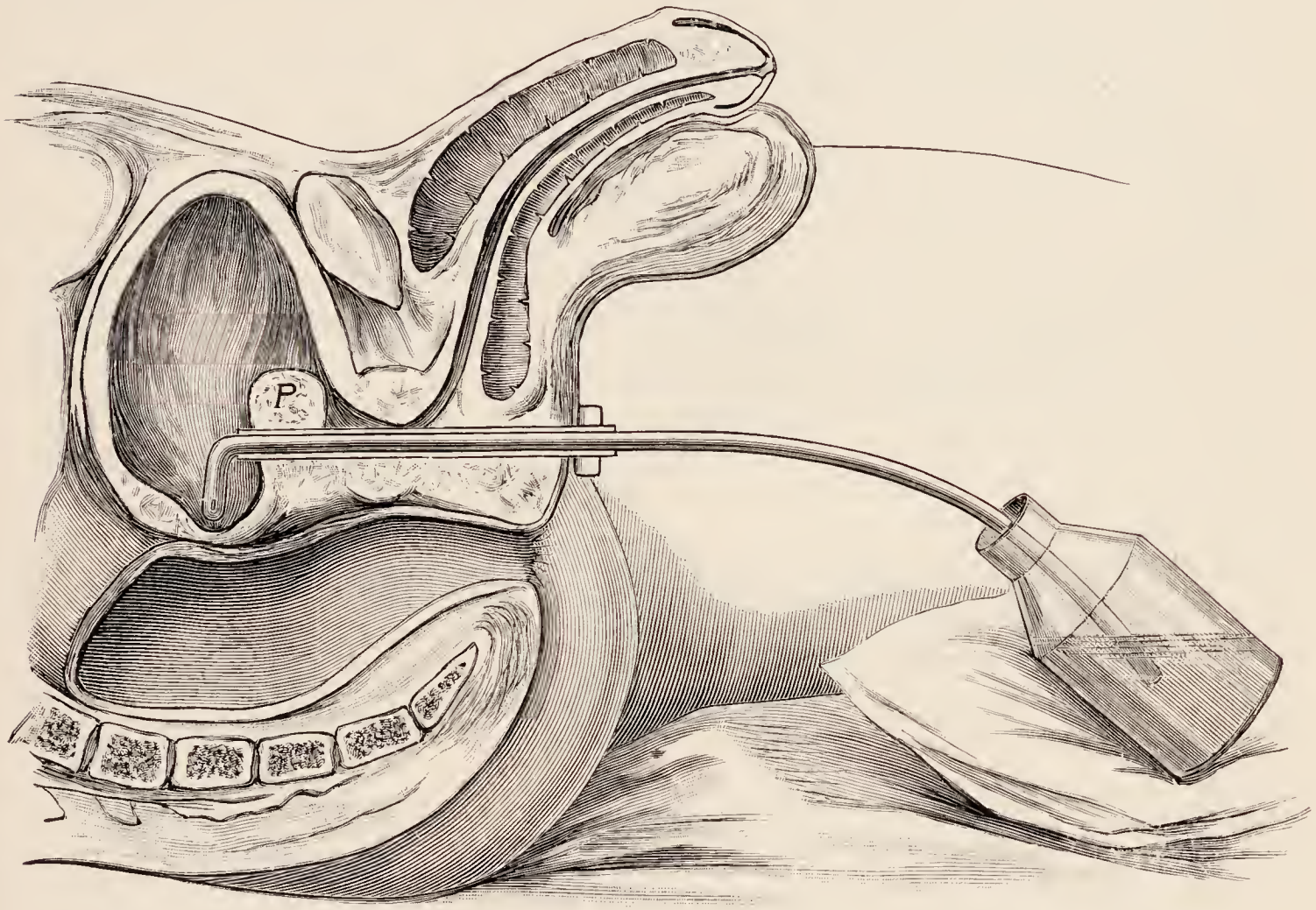



Fig. 1315.—Harrison's method of perineal drainage. *P.* Enlarged prostate. Antiseptic solution in bottle.

The tube should be taken out every two or three days, sterilized, and reintroduced. This method of drainage is the best in most cases, and may be continued for many weeks, if necessary.

**Suprapubic Drainage.**—Suprapubic drainage of the bladder after suprapubic cystotomy will depend upon the condition for which it is employed and the probable time for which the tube will be retained.

In operations where there has been little hæmorrhage the bladder may be drained by a single tube. Where there is a possibility of a single tube becoming plugged, either by blood clot or by masses of muco-pus, two tubes should be employed. The tubes should be of red rubber, flexible, and about twenty inches in length; the best size is about 26 F. The vesical end of the tube should be cut obliquely, and the sharp end trimmed smooth; a large fenestrum should be cut in the side near the extremity of the tube.

When a single tube is used it is passed into the bladder so that its end nearly reaches, but does not touch, the lowest part. A safety pin is then passed through its wall at the skin level. The bladder wound is sutured with chromicized catgut up to the tube, care being taken that no stitch passes through the mucous membrane. The outer wound is then united by deep silkworm-gut sutures. The dressing consists of a pad of gauze per-

forated to admit the tube, and close to this another safety pin is passed through the wall of the tube; the pins prevent the tube from slipping. Gauze pads are then applied and held in place by strips of adhesive plaster. The tube is then attached to a siphon apparatus, as already described. This plan of drainage is highly commended by Alexander.

*The Remarks.*—When suprapubic drainage is used after operations upon the bladder which are likely to be followed by hæmorrhage, it is better to employ two tubes. These are adjusted in the same manner as has been described above. The siphonage appliance is attached to the lower tube and the upper one is clamped by a pinch forceps. The bladder can be washed by injecting fluid into one of the tubes, the wash flowing out of the other. Stripping of the tube with the thumb and finger may be needed to eliminate the air when the siphonage is broken.

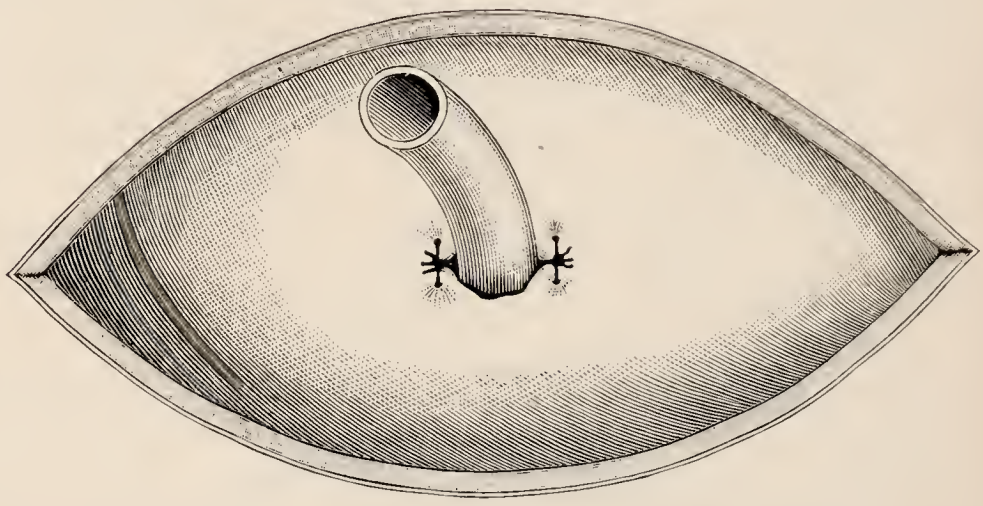


FIG. 1316.—Drainage of the bladder, Gibson's method. Tube inserted and stitches employed to diminish size of opening.

**Gibson's Method of Drainage.**—Gibson, noting the excellent practical outcome of Kader's method of gastrostomy (page 751) in controlling the opening into the stomach, applied this practice to drainage of the bladder with commendable results.

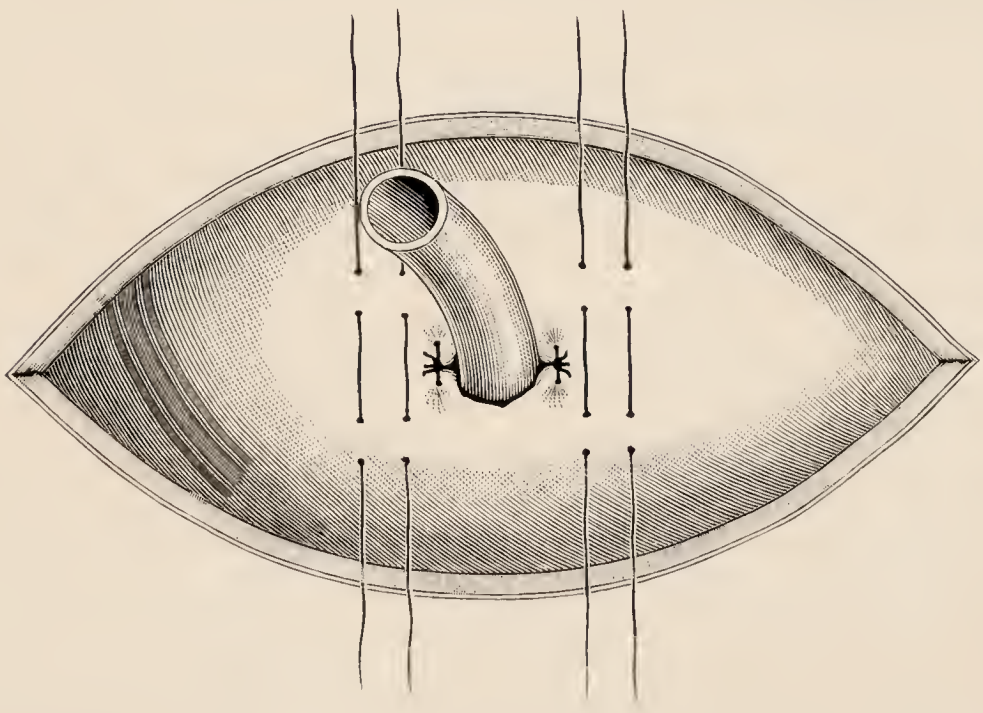


FIG. 1317.—Drainage of the bladder, Gibson's method. First set of inversion sutures in place ready for tying.

*The Operation.*—A rubber tube (32 F.) is passed into the bladder through a snug-fitting opening, and the bladder wall is brought closely around it by passing through the wall at either side (Fig. 1316) of the tube a Lembert suture. The first of the inversion sutures are then introduced (Fig. 1317). These sutures are tied, cut short, and "a second set is applied and tied (Fig. 1318), thus increasing the depth of the burial of the tube in the wall" (Fig. 1319). The tube is then secured in place by a catgut suture connecting it with the bladder wall. The ends of the second set of sutures are left long and utilized in the closure of the abdominal wound snugly around the tube. "Perfect

drainage is effected by leading the tube into a receptacle, which need not be filled with fluid of any kind." On removal of the tube the artificial opening is guarded by the valve arrangement of the infolded bladder wall, which is readily pushed aside by the catheter employed in relieving the bladder, without the annoyance of subsequent leakage. It appears to the writer that this simple method affords a great advance in effective bladder drainage in either acute or chronic requirement.

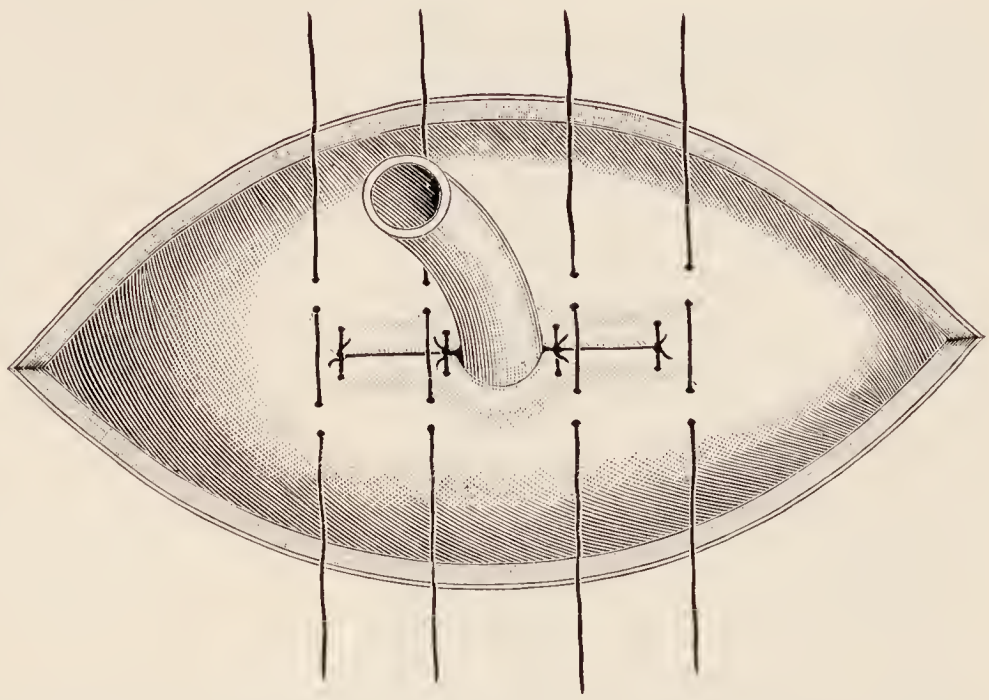


FIG. 1318.—Drainage of the bladder, Gibson's method. First set of sutures tied, second in place for tying.

**Dawbarn's Apparatus for Bladder Drainage.**—This plan of action is based on the old principle of intermittent siphonage, an idea of respectable age and useful employment (Fig. 1320). The following is substantially a statement, made by Dawbarn, of the apparatus:

"*d* indicates the clamp which comes with every fountain syringe. It has been removed from the end and snapped upon the side of the tube, so as almost to close it, permitting flow only drop by drop. Forcipressure may be employed instead.

"*a* indicates the joint between two or three pieces of rubber tubing. The simplest way, if one has a glass, metal, or vulcanite T tube, is to use it in making the connection. But if not, the joint is made as follows: Cut out a circle from the side of the exit tube from the bag. Sew the end of the other tube to the edges of this small hole. Make the joint tight with rubber cement (made by dissolving gutta-percha tissue in chloroform to saturation), and strengthen the union by wrapping around it narrow strips of rubber adhesive plaster.

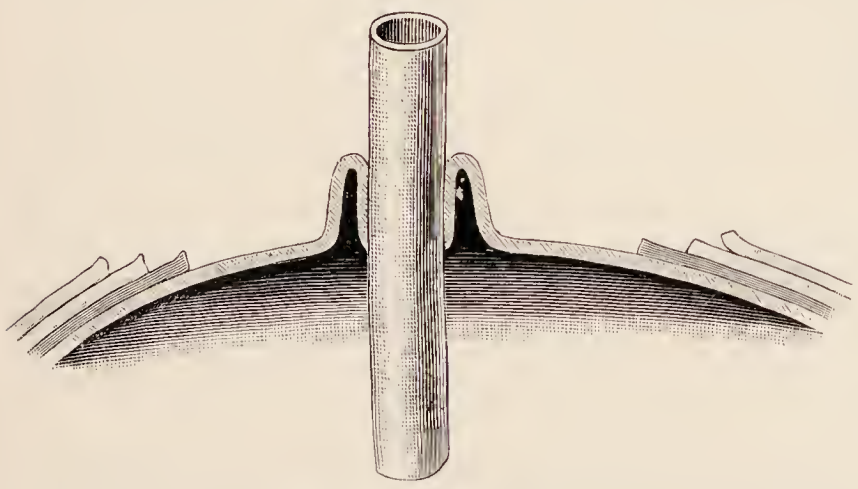


FIG. 1319.—Drainage of the bladder, Gibson's method. Longitudinal section, showing bladder infolded by two sets of sutures.

"*b* indicates a trap which is absolutely essential. The trap of the main exit tube, three inches across, is formed by knotting (as in the sketch) or by snapping on an elastic band around a loop of the tube.

"*e* indicates an apparatus introduced to collect urine (page 1128); a small piece of glass tubing a couple of inches long is employed when the apparatus

is not in use. The device operates as follows: the water trickles down from the reservoir until the trap (*b*) becomes filled; when overfilled it siphons off with a rush. This in turn makes a partial vacuum above the trap, which is filled by the drawing up of the urine in the bladder, thus forming a second siphon, causing the fluid to run freely from the bladder until it is empty.

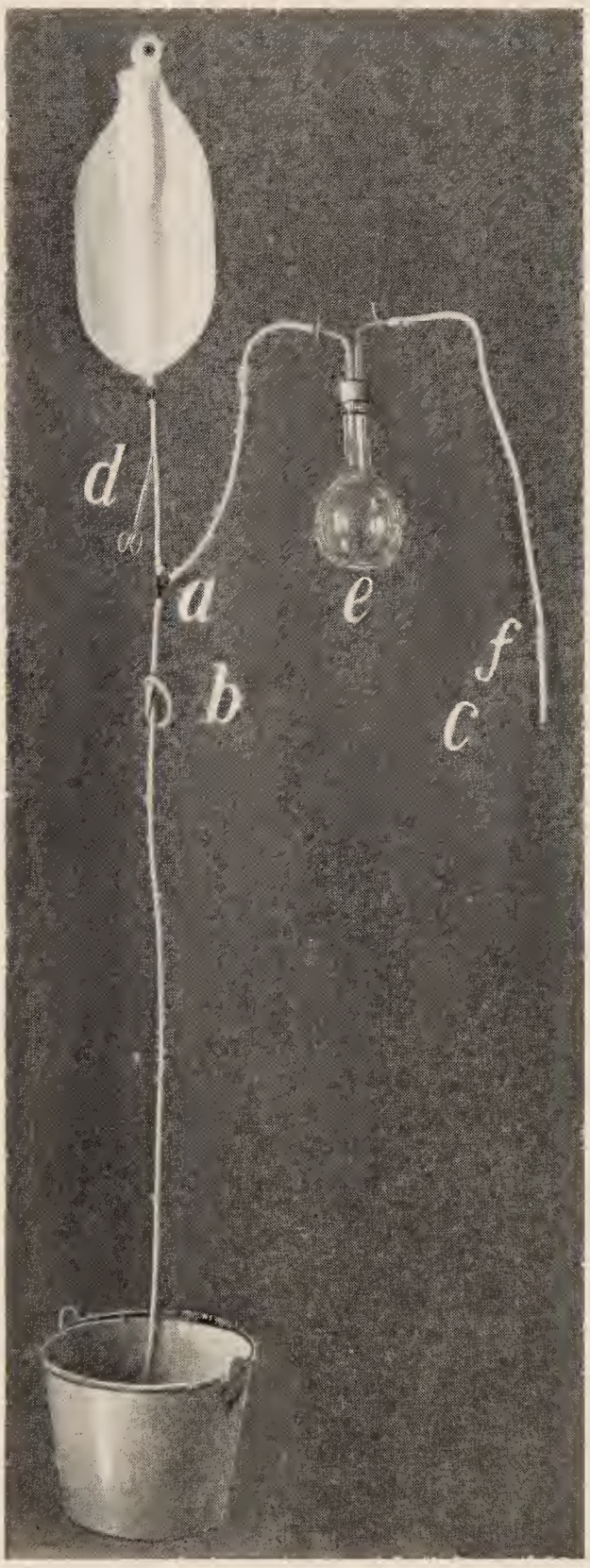



FIG. 1320.—Dawbarn's apparatus for bladder drainage. *a*. Point of junction of tubes. *b*. Knot trap in main tube. *c*. Opening in end of tube. *d*. Forcipressure limiting lumen of tube. *e*. Chemist's wash bottle. *f*. External segment of rubber tubing through which catheter passes into bladder.

"This process of intermittent siphonage repeats itself at regular intervals of any desired frequency. As a rule, if the flow from the reservoir be no faster than from one to two drops per second, this will suffice to prevent a bladder from overfilling. And at this rate of flow it is not necessary to replenish the bag of the fountain syringe oftener than once in several hours.

"Usually, a No. 20 to 24 F. soft catheter (*c*) is carried through the suprapubic wound to the bottom of the bladder. The catheter, like a stomach tube, should have two openings below, a second opening being cut opposite the original one, thereby preventing obstruction from the sucking in of a fold of mucous membrane. At the point of escape from the bladder the tube is fastened to the dressings with a safety pin.

"Should washing out of the bladder be desired, it is easily done without disturbing the wound. Take off the clamp (*d*) and pinch the tube tightly below *a*.

"The contents of the fountain syringe will then run freely into the bladder. Cease pinching below *a*, close the tube at *d*, and the fluid will run by siphonage out of the bladder into the bucket below.

"Sometimes it is desirable to know the exact amount and the appearance of urine drained away; also we may wish to analyze that urine undiluted by fluid from the reservoir.

"Then insert in a break (*e*) at any point in the tube leading from the bladder the chemist's wash bottle with its usual equipment—a tight-fitting rubber stopper and two glass tubes—thus the urine can be collected and the amount and characteristics can be determined."

*The Remarks.*—The catheter (*c*) is passed through a brief segment (*f*) of rubber tubing, which latter just enters the bladder, and is fastened to the

central tube with a stitch, and is held in place by another stitch connected to the plaster dressing of the wound. Air can pass between the tubes. If the urine be thick a larger catheter (No. 30 F.) should be employed.

**Artificial Urethra in Prostatic Obstruction.**—The formation of a so-called artificial urethra above the pubes in cases of obstinate prostatic obstruction is a measure of important moment in many instances attended with septic inflammation of the bladder. After thorough attention to aseptic details directed to the seat of the operation and to the vesical cavity, cause the elevation of the bladder above the pubes by the careful employment of the rectal bag and vesical injection, as in suprapubic cystotomy (Figs. 1407, 1408, and 1409).

*The Operation.*—Make a vertical incision in the median line three or four inches in length through the integument and fasciæ down to the upper border of the symphysis pubis; expose and divide by a shorter incision the linea alba vertically down to the pubes; separate the recti muscles in the median line and divide the fascia transversalis for two inches in length down to the pubis; expose the bladder by careful incision and displacement of the prevesical cellular tissue, leaving that part behind the pubes undisturbed; catch the exposed area of the bladder with a tenaculum and pull the viscus forward into the wound; open the bladder in the median line opposite the upper border of the pubes with a scalpel sufficiently to admit the index finger; introduce through the abdominal opening into the bladder a No. 10 or 12 E. soft-gum catheter; close the bladder and the abdominal wound around the catheter at the lower and the abdominal wound at the upper end with sutures; pass the catheter upward against the rectus and unite over it with deep silkworm-gut sutures the borders of the wound so as to form a fistulous communication with the bladder three or four inches in length; connect the distal end of the catheter by a tube with a receptacle of aseptic fluid placed at the side of the patient.

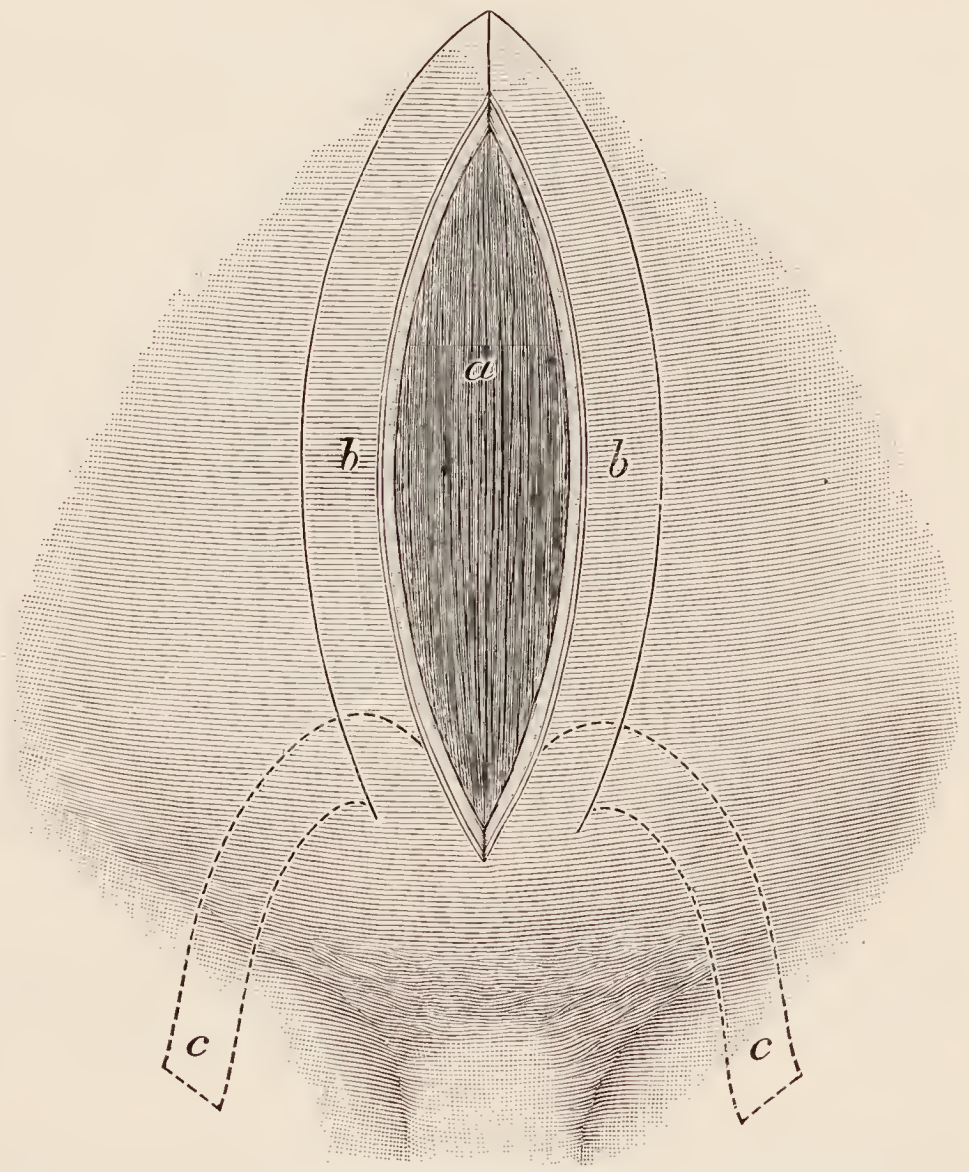



FIG. 1321.—Operation for artificial urethra, Morris's method. *a*. Aponeurosis of external oblique. *b*, *b*. Flaps. *c*, *c*. Outlines of displaced flaps.

*The Comments.*—If vesical tenesmus follow, the catheter should be removed and the drainage wick substituted. The urine is kept acid, absorbent cotton applied as often as needed, the patient kept in bed, and continuous urethral catheterism maintained if danger of urinary infiltration be apprehended. *McGuire* punctured the bladder, established a fistula with it, and regulated the discharge of urine by fitting to the fistula a silver plug held in place by a belt worn around the hips.

*The Results.*—The functional use of the sinus urethra is quite satisfactory in all respects. The intervals between the acts of micturition vary

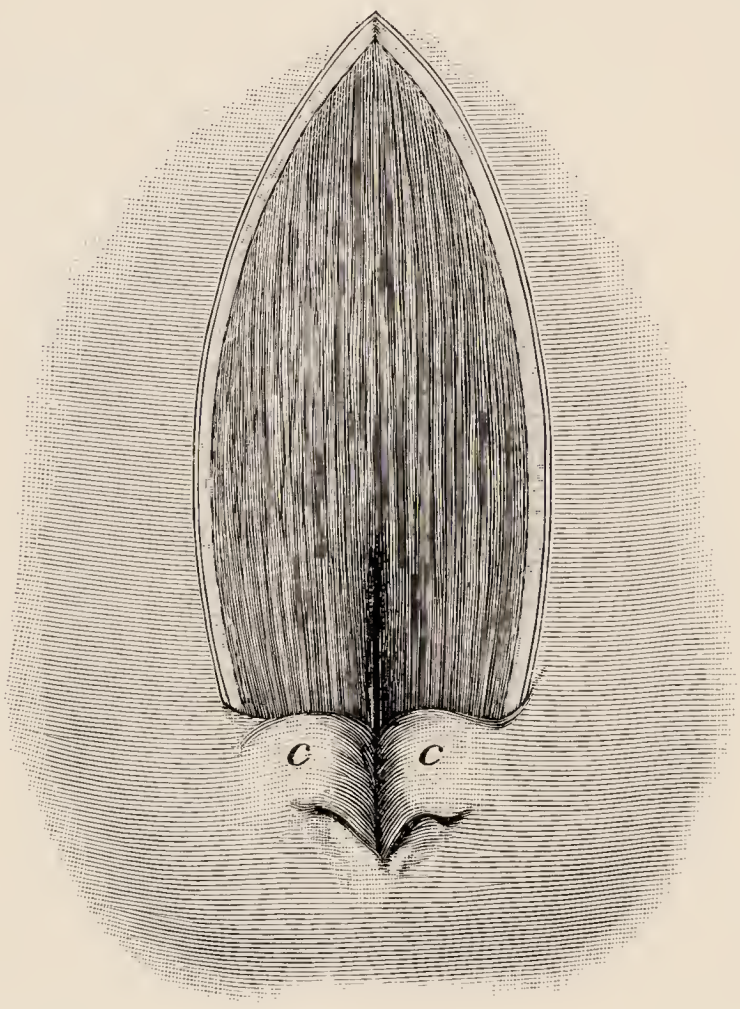



Fig. 1322.

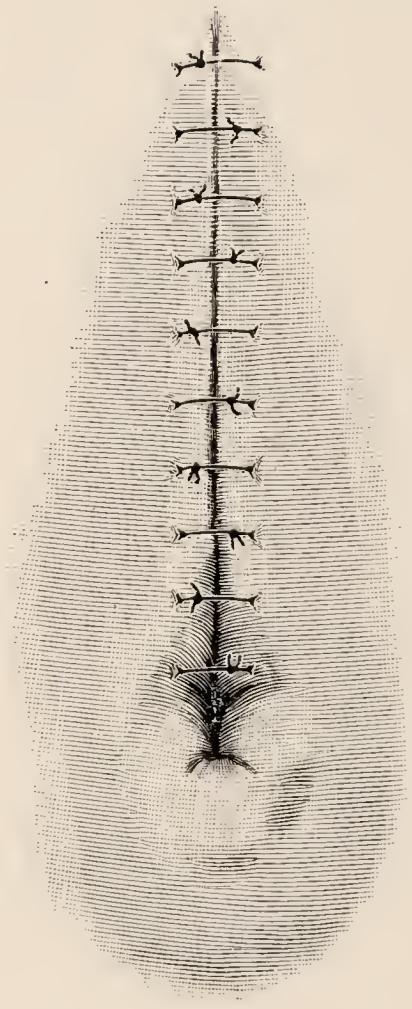


Fig. 1323.

Fig. 1322.—Operation for artificial urethra, Morris's method. *c, c.* Flaps turned inside.
Fig. 1323.—Operation for artificial urethra, Morris's method. Wound closed, showing orifice in lower end.

from two to six hours, and are not attended with discomfort, and the discharge of the urine is free and pronounced. Cicatricial narrowing is sometimes excessive and objectionable.

*Morris's Modification of McGuire's Operation.*—Morris proceeded after the manner of McGuire in exposing and opening the bladder. However, he temporarily stitched the bladder to the abdominal wall while preparing and attaching to the incision in the bladder the two skin flaps that constitute the modification. A skin flap a third of an inch in width and about three inches in length, including the fat and subcutaneous tissue, is dissected from either side of the abdominal incision and remains attached below (Fig. 1321). The free ends are turned inside so as to bring their cutaneous surfaces in contact with each other, and each extremity is sutured to the mucosa of the bladder at the respective side of the incision (Fig. 1322).

The retention sutures are then cut, and as the bladder recedes the cutaneous flaps are drawn into position. The upper portion of the wound is closed in the usual manner (Fig. 1323). Aristol is rubbed into the wound to lessen the danger of urinary infiltration, and the urine withdrawn by the drainage wick with one end in the bladder and the other lying on the abdomen.

This modification aims to establish a sinus with a cuticular lining and to secure the benefits of such a provision. *Morris* now regards it advisable to make the flaps wider. *Moullin* employed the flaps, leaving them attached at the upper instead of the lower end in order that he might establish a larger urethra. The plan answered well at first, but soon obstruction occurred in the passage at the junction of the cutaneous and mucous structures, which was a source of much annoyance. The patient could retain the urine for three or four hours, and expel it guided away from the body by a tube placed at the orifice. *Gibson's* method of drainage bids fair to eliminate these more complicated operations from the needs of surgical technique.

**Prostatectomy.**—Prostatectomy is an operation devised for the removal of all or a part of the hypertrophied portion of the prostate to secure relief from the following conditions:

1. When there is complete or almost complete retention of urine due to prostatic outgrowths about the internal urethral orifice or projecting into the prostatic urethra, making the patient entirely dependent at all times upon the use of his catheter. The consequences can not be doubtful in such cases, and operation affords the only means of averting fatal disaster.

2. When there is marked and continuous vesical irritability due to intravesical outgrowths which can not be allayed by the most careful catheterism and washing of the bladder. These patients usually suffer from frequent attacks of hæmaturia, and cystitis, when it develops, is usually severe.

3. When, in spite of careful catheterism, the amount of residual urine is steadily and surely increasing, showing a gradual failure of expulsive force in the bladder.

4. When catheterism is becoming more and more difficult in spite of all precaution, and when it is frequently followed by hæmorrhages.

5. When catheterism, in spite of all precaution, is frequently followed by attacks of cystitis.

6. In cases of long-continued vesical inflammation which do not yield to treatment.

7. In cases in which the patients can not or will not use a catheter and take the necessary aseptic precautions to make its use of value.

In a word, it may be stated that catheterism, with all that the term implies in the treatment of prostatic enlargement, should be employed in all cases until it fails to give relief; but that when it fails, and the integrity of the bladder and kidneys is threatened, we should resort to operative treatment before these organs have become hopelessly damaged (Alexander).

*Two routes of approach* to the prostate are practiced: the perineal and suprapubic routes. Two methods of procedure are advised in connection with the former route; one in which, after a perineal section, the growth can be reached with the finger, and on account of its small size, limited attach-

ment, and accessibility, can be readily removed through the perinæum with forceps and punches. *Gouley* practiced this method with signal success before and since 1885. This class of cases is comparatively infrequent, and though temporarily relieved by the treatment without especial danger to the patient, may soon again cause renewed affliction by continued growth. The outcome of this partial method of prostatectomy emphasizes the utility of the complete methods. The complete methods are applied to the organ above or below the pubis, as suits the nature of the case and the inclination and experience of the operator.

**Suprapubic Prostatectomy** (McGill).—Shave the pubis, scrub and wash the parts thoroughly; irrigate the bladder with the boric-acid solution, leaving a considerable portion (6 to 10 ounces) of the fluid in the viscus; introduce the rectal bag above the sphincters (page 1407) and distend it moderately (6 to 10 ounces).

*The Operation.*—Expose and open the bladder as in suprapubic cystotomy (page 1115); sew the borders of the opening to those of the abdominal wound with catgut; place the patient in the Trendelenburg position and expose the prostate to palpation and inspection by means of retractors and a strong light; incise the mucous membrane covering sessile growths, and enucleate the growths through the opening with the finger, aided by the curette or curetting forceps when required; sever pediculated tumors at the base with curved scissors and remove the growth; divide the collarlike growths into halves by cutting above and below the vesical orifice with scissors and follow by enucleation. The portion of the gland projecting into the bladder is cut in halves and each is separately enucleated and removed. Cutting should be avoided on all occasions when the same result can be accomplished by enucleation. The hæmorrhage is usually quite free, and promptly obscures the process of enucleation from observation. It is sometimes severe and may be even dangerous, requiring especial attention to prevent undue loss of blood. Hot water applied directly to the part with sponges or gauze, which are held firmly in place for a time, will usually suffice to arrest the flow. Informal packing with gauze, or the use of the gauze tampon devised by Keyes (Fig. 1324), or that of Cabot (Fig. 1325) may be required to arrest hæmorrhage. *Keyes* thus describes his tampon: "The tampon is made of bichloride gauze. A square of four thicknesses of gauze is first cut, the length of each side being about six inches. Upon this are placed eight thicknesses of gauze cut square, each side measuring four inches, and upon

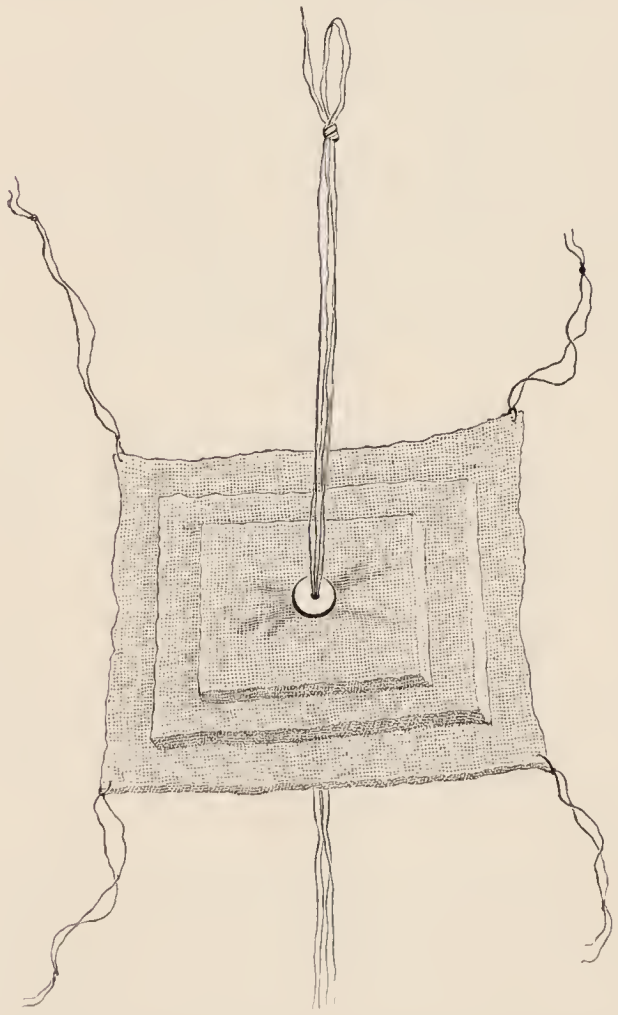


Fig. 1324.—Keyes's tampon in suprapubic prostatectomy.

this eight other thicknesses of gauze, also square, the sides measuring three inches. Centrally, upon the three-inch pad, a small white shirt button is tied by a stout silk ligature, transfixing the pad and tied upon the six-inch square surface. This central button also has a piece of silk attached to it, running out freely in the direction away from the three-inch surface. This is to facilitate extraction. Each of the corners of the six-inch pad is stoutly tied with a piece of silk, and the silk from each of these four corners is knotted at its end into a double knot, while the silk running out backward from the button is tied with a single knot, for the purpose of distinguishing which is which when making the extraction; although practically it will be found that they must all be made taut and pulled upon all together in order to effect removal with the greatest ease and facility." This tampon is applied through the suprapubic opening to the bleeding surface, and held firmly in place by a cord attached to it and passed through a perineal opening of the urethra and secured externally by a roll of gauze. The tampon is rarely retained longer than twenty-four hours. The bladder is drained through the suprapubic opening by one of the various methods of drainage already described. Frequent and sometimes continuous irrigation of the bladder is practiced for a few days. The construction of Cabot's tampon is explained by the illustration.

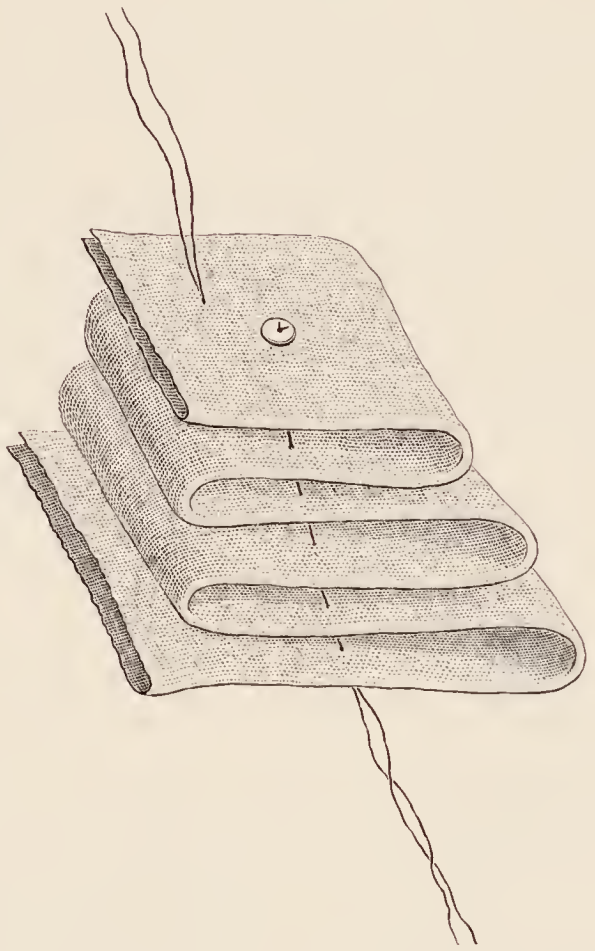


Fig. 1325.—Cabot's tampon for suprapubic prostatectomy.

*The Comments.*—Prostatectomy should not be practiced hastily, but rather during a quiescent state of the disease, if possible, to avoid undue hæmorrhage and reaction. It is wise in severe and offensive cases to establish preliminary drainage of the bladder for a time before attempting prostatectomy, thus dividing the procedure into two stages—preliminary and final. If the bladder be much contracted, its distention so as to appear above the pubis may be attended with not a little danger of rupture. However, vesical distention and peritoneal elevation are of less operative importance than is the support given the prostate by the distended bag. The opening into the bladder is made at the most prominent portion of the anterior surface, and should be large enough at first to admit the index finger readily. *Fuller* exposes the prostatic structure with scissors, inserts the fingers into the incision and enucleates the growth, while firm upward pressure is made on the perinæum. Suprapubic and infrapubic drainage is then established. He advises that the incision of the mucous membrane covering the enlargement be made as small as is consistent with a proper enucleation with the fingers. If the prostate be fibrous and hard, enucleation will be very difficult, if not impracticable, and cutting with biting forceps

must be employed instead for the removal. While a practical success depends on the complete removal of the growth, still, the amount removed should be measured by the demands of the case. Posterior and lateral encroachment of the growth on the canal should be removed so as to form a funnel-shaped orifice with a low and level urethral floor at the prostatic opening. Drainage of the prostatic portion of the urethra is best made through the perinæum, as suprapubic drainage is better adapted to intravesical operations. A perineal incision provides not only drainage, but the opportunity to support the prostate body during its removal. Suprapubic entrance is not admissible for the purpose of prostatectomy when the bladder is contracted to a small hard sac. Hard prostates yield less to pressure than the soft, and therefore they require less rectal distention. A suture should be introduced at the lower angle of the abdominal wound to lessen the possibility of urinary infiltration. Introduce the finger into the vesical opening to see if the urethra is intact before leaving the wound. *Kümmel* sutured the bladder and drained through the perinæum with a catheter. *Keyes* in dense cases at the neck employed the rongeur for removal.

*The Results.*—Complete cure does not follow the operation in the majority of the cases of recovery, because of the structural changes in the bladder. Therefore, the ultimate prognosis of early operations is better than those done at a later period. In 6 only, of 37 operations, was the function of micturition restored (Vignard). Complete functional cure is limited to less than 25 per cent of the cases of recovery. The death rate is from 18 to 20 per cent for all operators (Alexander). *Alexander* records the following objections to the suprapubic method:

"1. That the mucous membrane of the bladder and that of the prostatic urethra are cut through, and more or less torn and bruised.

"2. That the hæmorrhage is frequently severe, and requires packing of the wound to control it.

"3. Another and still more vital objection to these methods is that, after prostatic obstruction is removed, a cavity is left which is freely accessible to the urine. In this the urine collects, and, as this is often foul in the cases operated upon, there is great danger of septic infection. Nor can this cavity from which the prostate has been removed be efficiently drained. Suprapubic drainage alone is entirely inefficient, and even when perineal drainage is employed, the tube, in order properly to drain the bladder, must be placed above the level of this cavity."

**Perineal Prostatectomy.**—Small median tumors and portions of the lateral lobes can be reached through this incision, and removed by means of the finger, scissors, forceps, etc.

*The Operation.*—After the usual preliminary preparations, place the patient in the lithotomy position; introduce a staff as for the operation of perineal cystotomy; insert the left index finger into the rectum, and steady the beak of the instrument by pressing against it at the apex of the prostate with the point of the finger; thrust a narrow-bladed, double-edged knife into the median rhaphe half an inch in front of the anus, tilting the staff at the point where it is steadied by the finger; incise the apex of the

prostate and open the prostatic urethra by advancing the point of the knife along the groove in the staff as the knife is withdrawn.

*The Remarks.*—*Watson* regards the method favorably for partial or complete removal of intravesical growths in two thirds of the cases. If the prostatic urethra be so much lengthened, because of the hypertrophy, that the finger is not available for exploration purposes, this method of operation should not be practiced.

**Dittel's Method** (*Lateral Prostatectomy*).—Dittel recommends removal of either lateral lobe of an enlarged prostate through a cuneiform incision (Fig. 1326). A catheter or sound is introduced into the bladder through the urethra, and held in place to enable the surgeon to recognize and avoid the urethra. The rectum is packed with gauze to secure its prompt recognition and consequent safety. The patient is placed on the table, the back uppermost, and body oblique for better opportunity of breathing, the legs of the patient hanging over the end. An incision is made from the tip of the coccyx, down the median line to the middle of the external sphincter, thence around the anus nearly to the rhaphe in front. The prostate is freely exposed through the incision, the capsule incised, and the enlargements are removed, leaving sufficient tissue to insure the urethra from injury. The wound is then cleansed, drained, and lightly packed. Several successful cases of this method of practice are reported, and on the whole it is entitled to favorable consideration. *Pyle* gains ready and uneventful access to the prostate through a perineal incision similar to that employed in bilateral lithotomy (Fig. 1402, *c*). After division of the anal fasciæ and separation of the fibers of the levator ani muscle, the prostate is exposed and enucleated.

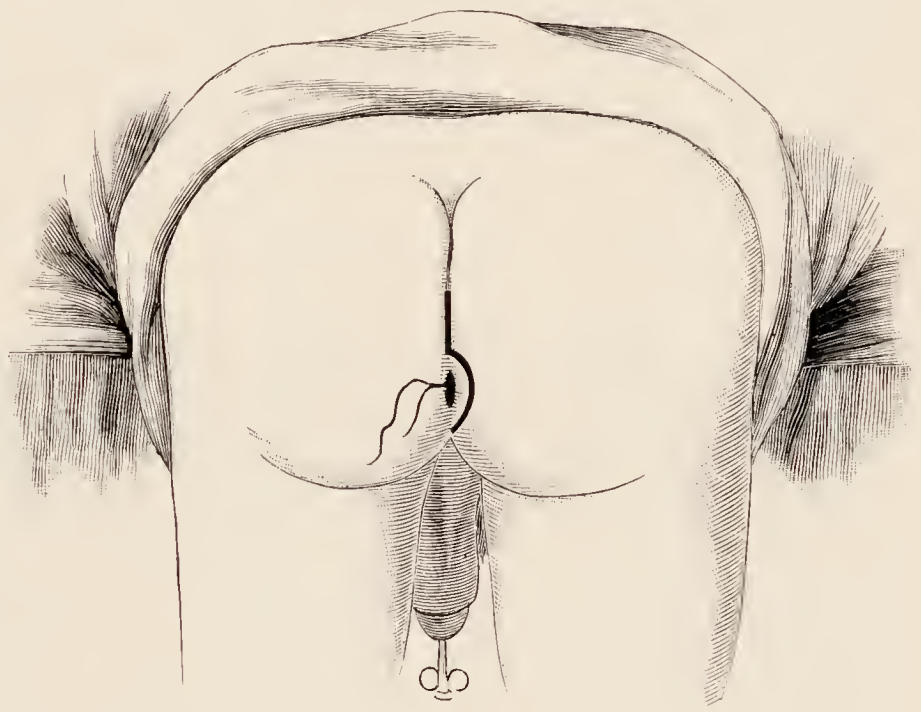


Fig. 1326.—The operation of lateral prostatectomy. Dittel's method. String attached to gauze packing protruding from anus.

**The Combined Method** (Belfield).—The importance of the combination of perineal and suprapubic manipulation in prostatectomy was first noted by *Belfield*. However, to *Nicoll* belongs the credit of maintaining the integrity of the mucous membrane of the bladder at the base, and thus preserving the perineal wound from vesical infection.

*The Operation.*—Suprapubic cystotomy (page 1115) is first performed. The wall of the bladder is secured to the skin by five sutures—one at the lower angle—the mucous membrane is thoroughly cleansed, and the bladder cavity is partly filled with carbolic solution (one part in two hundred). The patient is then placed in the lithotomy position, and a sound or bougie

is passed into the bladder and given to an assistant. With the left forefinger in the rectum, an incision is made in the perineal rhaphe and gradually deepened without penetrating the urethra or the bladder until the apex of the prostate is reached. The rectum is carefully separated from the posterior surface of the prostate, and a vertical incision is made through the posterior and inferior part of the prostatic capsule. The capsule is gradually separated from the gland at either side by means of a periosteal elevator or a like blunt instrument. The assistant meantime is pressing the prostate down into the perineal wound with his fingers, introduced into the bladder through the suprapubic opening. (If sufficient room for the isolation of the prostate is not afforded by the median perineal wound, additional room may be obtained by supplementing the median incision by a lateral one, curved outward and backward, beginning at the posterior end of the median cut and curved outward and backward to a point between the anus and the posterior part of the tuber ischium, nearer the former than to the latter. This incision may be made at one or both sides.) All bleeding points having been secured, the surgeon, after carefully washing his left index finger in a carbolic solution, puts it and the middle finger of the left hand into the bladder through the suprapubic wound, and, while pressing the prostate down into the perineal wound, removes through the perinæum, with the fingers of the right hand, the entire prostate, or as much of it as he deems necessary. A sufficient amount should be removed to relieve the neck of the bladder from pressure, and permit the bringing down of the neck to a level with the post-prostatic pouch at the base of the bladder. One judges of the amount to be removed by manipulating the parts between the fingers of the two hands. If the prostatic tissue proves to be tougher and more resistant than usual, the fingers of the right hand may be supplemented by the careful use of a blunt periosteal elevator, and even by Volkmann's spoon. During the entire operation neither the bladder nor the urethra is opened, except as the former is involved by the suprapubic incision. After enucleation is completed, the instrument is withdrawn from the bladder and a large-eyed, short-beaked metal catheter (like a lithotrity evacuating catheter), or a large gum-elastic catheter coudé is introduced and tied in place. The perineal wound is douched with a weak carbolic solution, carefully dried with gauze or sponges, and firmly stuffed with iodoform gauze. The five stitches in the suprapubic wound are cut, removed, and the bladder is permitted to drop from the abdominal wall.

*The after-treatment* consists mainly in douching the bladder daily through the suprapubic wound with boracic fluid or a weak solution of carbolic acid, which escapes through the catheter. The iodoform packing is changed every second or third day for a fortnight and then discontinued and the wound allowed to close. The suprapubic wound is dressed with a pad of sublimated gauze, and begins to close about this time. The douching then may be discontinued.

The comparative advantages of this method of prostatectomy appear to be the following: *a*. The hæmorrhage is much less. This is what *à priori* might be expected. The prostatic plexus of veins lies on the surface of the pros-

tate, and is therefore chiefly removed along with the capsule. Furthermore, the plexus is chiefly located at the anterior and lateral aspects of the organ. In approaching the prostate on the posterior and inferior surfaces but few veins are encountered. *b.* The infiltration of freshly wounded tissues by the putrid and septic urine is avoided. In adequate removal of the body and lateral lobes a large gaping cavity remains. In the suprapubic operation no efficient means of draining this cavity is known. The depth of the cavity in these cases is such that it is not properly drained through the penis, and the fluid remaining behind is liable to decompose, which can not occur in this method of operation. *c.* The operation insures adequate removal of the obstructing prostatic tissue, thereby avoiding a chief source of failure to give relief peculiar to the perineal and suprapubic operations. *d.* The preservation intact of the bladder wall insures less risk of tearing the deep urethra, and therefore chiefly obviates the occurrence of the serious complications mentioned above. With a sound in the urethra and the fingers in the bladder there can, with care, be little chance of removing any of the bladder or urethral wall along with the prostatic tissue. *e.* The absence of a perineal tube permits the patient to sit from the first without inconvenience.

*The Remarks.*—In the instances of median lobe involvement, *Nicoll* advises that the removal of this portion be omitted for eight or ten days, or until the urine is aseptic and the perineal wound is covered with granulation, thus avoiding infiltration.




FIG. 1327.—Transverse section of enlarged prostate immediately behind openings of seminal ducts. *a, a.* Enlarged anterior parts of lateral lobes (can be enucleated). *b.* Enlarged posterior part of lateral lobes (left after enucleation). + Upper wall of urethra, urethral opening appearing as a vertical slit, with the vera montanum below. (From Alexander's collection.)

**The Combined Method** (*Alexander*).—The writer desires to acknowledge his obligations to Dr. Alexander for his kindness in furnishing the following statement, which is quoted in full:

"The object of this method is to remove those portions of the enlarged prostate which cause obstruction, with as little injury to the urethra and bladder as possible. It is based upon the following *anatomical facts*, which have been demonstrated by the writer: 1. The prostatic urethra may be divided surgically into two parts, the one lying above the openings of the seminal ducts (vesical portion), the other lying below the seminal ducts (urethral portion) (Fig. 1327). The walls of *the vesical portion* of the prostatic urethra are comparatively thick, and from this portion of the urethra the prostate may

be easily removed without injury to the mucous membrane. The walls of *the urethral portion* of the prostatic urethra are much thinner and depend very largely for their support upon the prostatic tissue which surrounds the canal. 2. From the central *fibrous portion* of the prostate, which lies behind the urethra, there extend laterally outward strong trabeculæ to the fibrous




FIG. 1328.—Longitudinal section of enlarged prostate and part of posterior wall of bladder. *a*. Enlarged anterior part of left lateral lobe (can be enucleated). *b*. Enlarged posterior part of left lateral lobe (left after enucleation). *c*. Seminal duct. *d*. Posterior wall of bladder. + + Line of prostatic urethra. (From Alexander's collection.)

capsule of the gland. These trabeculæ divide the lateral lobes into two parts—viz., 1, a portion lying in front of these trabeculæ, and lying at the side of the urethra; this is the only portion of the lateral lobe which by its enlargement causes obstruction to urination (Fig. 1328); 2, a portion lying below or behind these trabeculæ—that is, behind or below the urethra and behind and below the seminal ducts—never is by its enlargement a cause of obstruction to urination (Fig. 1329). The portion of the lateral lobe which causes obstruction can be enucleated *en masse*, leaving the posterior portion of the lateral lobe and the capsule intact. The fibrous trabeculæ mentioned above form the line of cleavage between the anterior and posterior portions of the lateral lobes.

"*The Preparation of the Patient.*—The patient is prepared as for any major surgical operation. It is important, when possible, to devote a few days before the operation to an attempt to diminish infection of the bladder by careful catheterism and washing, and by the internal administration of full doses of urotropin. The patient being etherized the bladder is emptied and is then distended with a sterile salt solution, from eight to ten ounces being sufficient in most cases to bring the organ well above the pubes.

"*The Operation.*—The bladder is exposed in the space of Retzius by a vertical incision between the recti muscles; two traction sutures are introduced through its anterior walls. Between these sutures an opening is made into the bladder large enough to permit the operator to pass his finger. The condition of the bladder and the intravesical projections of the prostate can now be thoroughly examined by digital exploration. The edges of the bladder wound are then united to the skin by a single temporary

stitch on each side. The suprapubic opening is now covered with gauze, and the patient is placed in the lithotomy posture. A broad, median-grooved staff is passed into the bladder and held by an assistant. The membranous urethra is opened by a free median perineal incision, cutting through the floor of this portion of the urethra from just behind the bulb to the apex of the prostate. The operator introduces his finger into the wound, and as the staff is withdrawn the finger is passed through the prostatic urethra into the bladder for the purpose of dilating the canal. The operator now again washes and disinfects his hands, if they have been soiled. He then passes the forefinger of his left hand through the suprapubic wound into the bladder, and presses the prostate downward into the perinæum. The forefinger of his right hand is introduced through the perineal wound into the urethral part of the prostatic urethra and begins the process of enucleation. This is performed as follows: The operator feels in the lateral wall of the prostatic urethra for a prominence due to the enlargement of one of the lateral lobes, and breaks through the mucous membrane immediately in front of this prominence. As soon as this is done the finger passes between the anterior and posterior portions of the lateral lobe in the line of cleavage formed by the fibrous trabeculæ spoken of above. The obstructing portion of the lateral lobe is easily separated on its lateral and posterior surfaces from the posterior part of the prostate and its capsule. It is then separated from the mucous membrane at the vesical neck and from the upper




FIG. 1329.—Longitudinal section of enlarged prostate and part of posterior wall of bladder. *a*. Moderate intra-urethral projection of left lateral lobe. *b*. Enlargement of the posterior part of the left lateral lobe. *c*. Seminal duct. *d*. Part of left wall of bladder. *m*. Enlarged middle lobe projecting upward into bladder, causing a crescentic-shaped urethral orifice (may be enucleated). (From Alexander's collection.)

portion of the prostatic urethra; during this part of the operation the mass to be enucleated may be seized with forceps passed into the perineal wound and drawn down into the perinæum. The finger in the bladder

may be passed into the urethra during this procedure, and prevents tearing the mucous membrane. Having removed the obstructing growth from one lateral lobe, a similar procedure is done upon the other side if necessary. When a so-called middle-lobe enlargement exists, this can be removed by pressing it down from above into the cavity formed by the removal of the lateral lobes, when it can be easily removed in the same manner. The only part of the urethra torn is that in front of the opening of the seminal ducts. After removal of all the obstructing portions, the wound and bladder are flushed with a hot saline solution; hæmorrhage is controlled by pressure; a large catheter, about 30 F., with thick walls, is introduced into the bladder through the perinæum and a rubber drainage tube with a single eye near the end is inserted into the bladder through the suprapubic tube. The bladder is then closed about this tube in the manner recommended by Gibson (page 1126), the perineal tube is retained in place by tapes fastened to a waist band, and the bladder is drained through the perineal tube by siphon. The after-treatment consists in daily washing the bladder. The upper tube is removed on the fourth day and the lower tube at the end of one week. Both wounds have usually healed by the end of five weeks. The advantages we have claimed for this method are: 1, the entire obstructing portions of the prostate are thoroughly removed through a perineal opening without injury to the mucous membrane of the bladder, or of the prostatic urethra above the opening of the seminal duct; 2, hæmorrhage is rarely a serious complication; 3, the most efficient and thorough drainage of the bladder is secured; 4, the time required by practiced hands to perform the operation is comparatively short; 5, the best conditions are left for a return of complete voluntary urination.

"*The Dangers of the Operation.*—Dangers of the operation are: 1, suppression of urine in those cases in which there is advanced renal disease; 2, hæmorrhage. Hæmorrhage is rarely serious, and can always be controlled by packing the perineal wound with gauze about the drainage tube; 3, injury to the rectum. This may occur at the time that the obstructing portions of the prostate are detached from the anterior portion of the urethra. It is, however, necessary only to remember this danger to avoid it.

"*The Results.*—The results of the operation in our hands have been good, considering the very bad condition of most of the patients operated upon. The following is a summary of the writer's cases: 31 cases, 3 deaths, 1 due to sepsis; 1 due to uræmia; 1 due to sepsis and uræmia. One partial success: the patient emptied his bladder completely, but had, at last reports, a small rectal fistula, resulting from a tear into the rectum during operation; 27 successful cases, in which the vesical function was restored, the patients emptying their bladders completely."

*Many modifications* have been advised and practiced with the idea of avoiding the suprapubic cystotomy element of the combined method. The knowledge of the fact that Alexander was able in two very thin subjects to dispense with suprapubic cystotomy and successfully enucleate the prostate aided by pressure with the hand made behind the symphysis, prompted *Syms* to advise that the prostate be pressed against the perinæum from

within the abdomen by the hand carried through an incision made in the median line just above the vesical fold of the peritonæum. The liability to infection and to injury of the bladder from undue pressure and from serious involvement of the organ by the enucleating process are, though sufficiently obvious to invite preventive caution, of such an apparent gravity in other than skilled use as to expose the method to wise practical objections. Syms suggested also the introduction through the perineal incision into the bladder of a collapsed soft-rubber bag to which is attached a strong, thick rubber tube. The distention of the bag with water, followed by gentle downward traction on the tube, serves to draw down and steady the prostate so that enucleation may be practiced through the perineal incision. *Johnson* made a small opening just above the pubis into the space of Retzius (*e*, Fig. 1378), through which the finger was introduced, carried down to and caused to press upon the prostate while the enucleation was successfully performed through the perineal incision. It is evident that this plan is best suited to small and thin patients. *Mynter* reports a case of enucleation accomplished with comparative ease and practical success upon a large, stout patient (two hundred and forty pounds) in the following manner: The posterior extremity of the usual longitudinal incision was extended backward in a curved manner so as to correspond to the anterior half of the circumference of the anus. The curved flaps were reflected outward and the prostate exposed to view. A grooved staff was then introduced into the urethra to afford a better outline of the canal in the prostate. A median incision was made into the posterior part of the prostate without opening the urethra, through which wound the enlarged lateral and middle lobes were easily enucleated with the finger while manual pressure from above behind the symphysis pubis was made on the prostate. In this instance the pronounced borders of the grooved staff contributed to rupture of the urethra during enucleation. Venous oozing from the prostate characterized this case for some hours after operation. *Fuller* exposes the gland with scissors, inserts the finger into the incision, and enucleates the growth while firm upward pressure is made on the perinæum. Suprapubic and perineal drainage is then established. *Guitéras* makes counterpressure on the prostate during intravesical enucleation by means of two fingers introduced into the rectum.

*The General Remarks.*—Complete and final cure from any method of operation should not be too confidently expected, but much relief and even practical cure happens in many cases. It is quite evident that the ideal method of practice is yet to be established, also that the many important novel suggestions of practical utility frequently presented by thoughtful, skillful operators may be regarded as an earnest of an early and final success. Enough, however, is already known to enable one to exercise wise discretion in the adoption of the method to fit the case.

*The Results.—Treves* quotes *Belfield* as follows: "Dr. Belfield gives the mortality of prostatectomy as 13 per cent, that of the perineal operation as 9 per cent, and of the suprapubic as 16 per cent. He gives the following table:

| Restoration of Voluntary Urination. | Cases. | Successes. | Failures. | Deaths. |
|---|---|---|---|---|
| By perineal incision ..... | 41 | 17 | 7 | 4 |
| By suprapubic incision .. | 88 | 29 | 12 | 12 |
| By combined incisions... | 4 | 3 | 0 | 1 |
| | 133 | 40 | 19 | 17 |

"The discrepancy in the totals of the second and third columns depends upon the fact that, in estimating the result of the operation, the author has omitted all cases in which the history after operation is imperfect."

*Desnos*, in 22 cases of his own, reports 2 deaths (with aggravated symptoms), 4 not improved, and 15 improved and cured.

**Castration, operations on the vasa deferentia, and ligature of the iliac arteries** are each practiced to a greater or lesser extent for the cure and relief of prostate hypertrophy. The technique of these various operations can be found under the proper headings, and the results only will be given at this time. In 1893 * *White* formally announced to the profession his belief in castration for relief from the afflictions of prostatic hypertrophy. Since that time many operations of this nature have been done, some of doubtful result, others premature, and many ill-judged, as will necessarily happen in novel proposals. However, sufficiently trustworthy results are now before us to establish the fact that castration should be regarded as one of the proper methods of treatment in selected cases. The sentimental objection will no doubt lead to delay that will lessen the benefit that otherwise might be experienced. There is not yet sufficient ground on which to rest a belief that the removal of one testicle exercises a beneficial influence. However, since isolated cases suggest the possibility of benefit, one may be removed, succeeded by the other if desirable.

*Fenwick* regards double castration of value in the following conditions: 1, in reducing bulky overgrowth of the lateral lobes of the prostate; it may be found that the small, tough, fibrous median or lateral vesical outgrowths will be better removed by suprapubic prostatectomy; 2, in controlling the distress and danger of an inflamed, senile, enlarged prostate; 3, in lessening the frequency or difficulty of introducing the catheter in advanced or confirmed catheter life; 4, in avoiding the mechanical difficulty of crushing a post-prostatic or a post-trigonal stone by leveling the base of the bladder, thus rendering the operation of litholapaxy feasible in a condition in which before it was impracticable; 5, in reducing chronic cystitis and recurrent phosphatic calculus in cases of confirmed catheter life.

*The Results.*—The death rate of operation is reported, 5 to 10 per cent in selected cases; permanently improved, 71 per cent; return of bladder contractility, 66 per cent; cystitis relieved, 52 per cent. No doubt a more extended experience will serve to place this plan in its proper station.

**Vasectomy** (*Albarran*).—The exposure of the cord as it escapes from the external ring, and in its course to the testis, followed by ligature or section

* Transactions of the American Surgical Association, 1893.

of the vas, or division of the nerves, or ligature of the arteries of the testicle, is quite an easy matter (page 1226). The vas deferens is recognized by its pearly, firm structure. It is located behind the testicle and posteriorly in the spermatic cord.

*The Results.*—The reported death rate of operation is quite as much as in castration; permanently improved, 59 to 82 per cent. In mild cases and in those who refuse castration vasectomy may be employed. But, since the danger is quite as great and the outcome not so good, castration should be given the preference as a surgical expedient.

**Ligature of the internal iliac arteries** (*Bier*) has been practiced by Meyer and others, but not with that degree of success that justifies the substitution of this measure for either of the preceding plans of treatment.

**The Galvano-cautery Method** (*Bottini*).—*Bottini* introduced to the profession the application of galvano-cautery for treatment of prostatic obstruction.

*The Operation.*—Thoroughly cleanse the bladder and urethra, and employ general or local anæsthesia; introduce into the bladder six or eight ounces of sterilized water; carry cautiously into the bladder the electrode; turn downward the beak of the instrument, and withdraw it until the beak is arrested by the base of the enlarged prostate; introduce into the rectum the index finger and note that the beak is properly located; turn on the current (45 ampères) and manipulate the wheel at the end of the instrument so as to burn a furrow through the prostate; arrest the current, change the direction of the beak to the right or left, at about a right angle with the primary application, and repeat the process; treat the opposite lateral lobe in a similar manner. During the time of action of the electrode, cold water is caused to flow from a fountain syringe freely through the catheter to prevent it from becoming overheated. The instrument is pushed into the bladder and allowed to cool before it is withdrawn.

*The Remarks.*—Afterward a catheter is tied in the bladder for a few days, and the patient given water freely and submitted to general and local bladder medication. Only the most approved apparatus should be employed for the purpose, and the measure of the current should be ascertained and kept in view during the proceeding. The bladder is washed freely with boric-acid solution sufficiently often to remove offending substances. Care should be employed in the introduction of the electrode, as the beaked end may catch in the triangular ligament (Figs. 1378 and 1379), especially with the employment of local anæsthesia.

*The Results.*—*Bottini* reports 67 per cent of cures, 15 per cent unimproved, 15.85 per cent no report, and 2.6 died, in a series of 77. Surely if these results are accepted as conclusive evidence of the resources of the method, it must be given its proper place in the list of means of relief.

*Clark*, *Meyer*, *McGowan*, *Guitéras*, and many others have contributed their confidence in the method, as emphasized by their operative efforts. However, the element of uncertainty that attends operations conducted in the dark, together with its novelty, prompts us to advise a suspension of judgment while abiding the outcome of still further demonstration.

**Prostatic Abscess.**—Prostatic abscess is preceded usually by an acute parenchymatous inflammation of the prostate body. The common directions of pointing of the abscess are toward the urethra, rectum, and the perinæum. Infrequently they point in the inguinal or the obturator region; sometimes in the space of Retzius and the peritoneal cavity. Prostatic abscess should be opened and drained as soon as the diagnosis is made, in order to forestall the escape of the pus into either of the places already indicated.

*The Operation* (Dittel and Zuckerkandl).—Evacuate and cleanse the rectum; shave and scrub the perinæum; place the patient in the position for perineal lithotomy; introduce a large sound into the bladder and give it in charge of an assistant; pass the left index finger into the rectum; begin a convex incision at the right between the tuber ischii and the rectum, and



FIG. 1330.—Curved transverse incision of perinæum for access to prostate, seminal vesicles, etc. Curve should conform to outline of incision in Fig. 1331 in latter instances of access.

carry it forward to the posterior limit of the bulbous urethra, thence symmetrically backward to a point at the opposite side corresponding to that of starting (Fig. 1330); divide the superficial fascia of the perinæum along the

line of incision and enter the ischio-rectal fossa at either side (Fig. 1331); separate the flap and turn it backward as far as the lower surface of the sphincter ani muscle; push at the same time the hæmorrhoidal vessels and

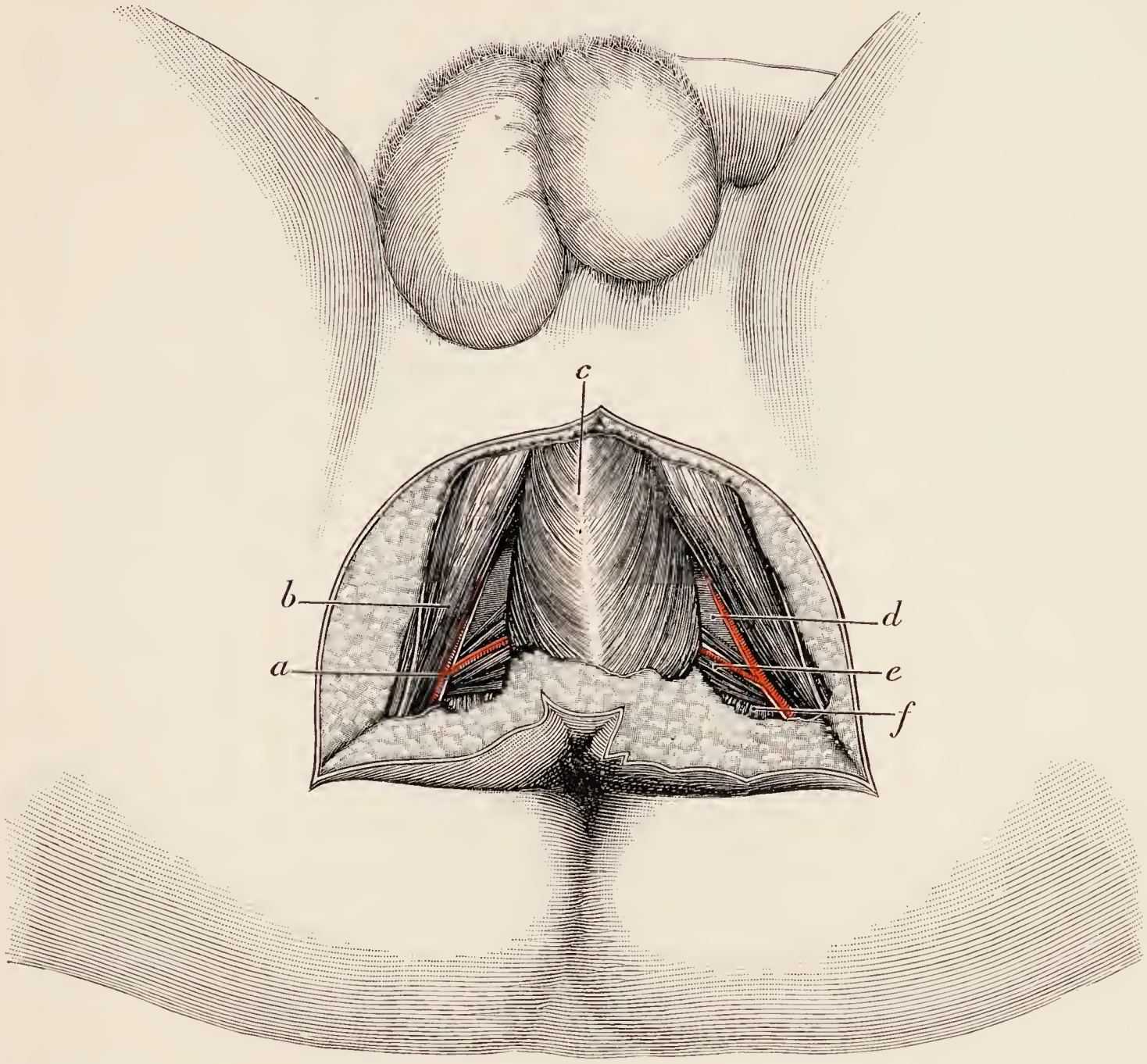



Fig. 1331.—Superficial surgical anatomy of perinæum. *a*. Superficial perineal vessels and nerves. *b*. Erector penis muscle. *c*. Accelerator urinal muscle. *d*. Triangular ligament. *e*. Transversus perineii muscle. *f*. Levator ani muscle.

nerves backward and the superficial perineal vessels and nerves and the bulb forward; divide the connecting fibers between the external sphincter ani and the accelerator urinæ muscles transversely, and draw the bulbous urethra forward; sever the anterior layer of the deep perineal fascia from the fascia in front of the levator ani at the bulb (anal fascia), and draw the muscle, the fascia, and the lower end of the rectum backward, thus exposing the deep layer of the triangular ligament at that situation, the compressor urethræ muscle, and Cowper's glands; dissect upward through the fascia without cutting; sever the transverse muscular fiber layer that connects the anterior bundles of the levator ani muscle at the anterior surface of the rectum; separate and draw aside the fibers of the levator ani so as to bring into view the posterior surface of the prostate and the seminal vesicles higher up (Fig. 1332); open through the sheath of the prostate into the abscess cavity carefully; evacuate, wash out the abscess, and drain with

a small tube or gauze wick; close the external wound with silkworm gut, except at the center of the perinæum, which is left open for drainage purposes. The abscess can be opened satisfactorily in thin subjects by a median perineal incision made behind the urethra into the sheath of the prostate.

After the detection of pus by the needle or by palpation, introduce the left forefinger into the rectum and locate the fluctuating point; failing in this, place the end of the finger at the apex of the prostate. Introduce

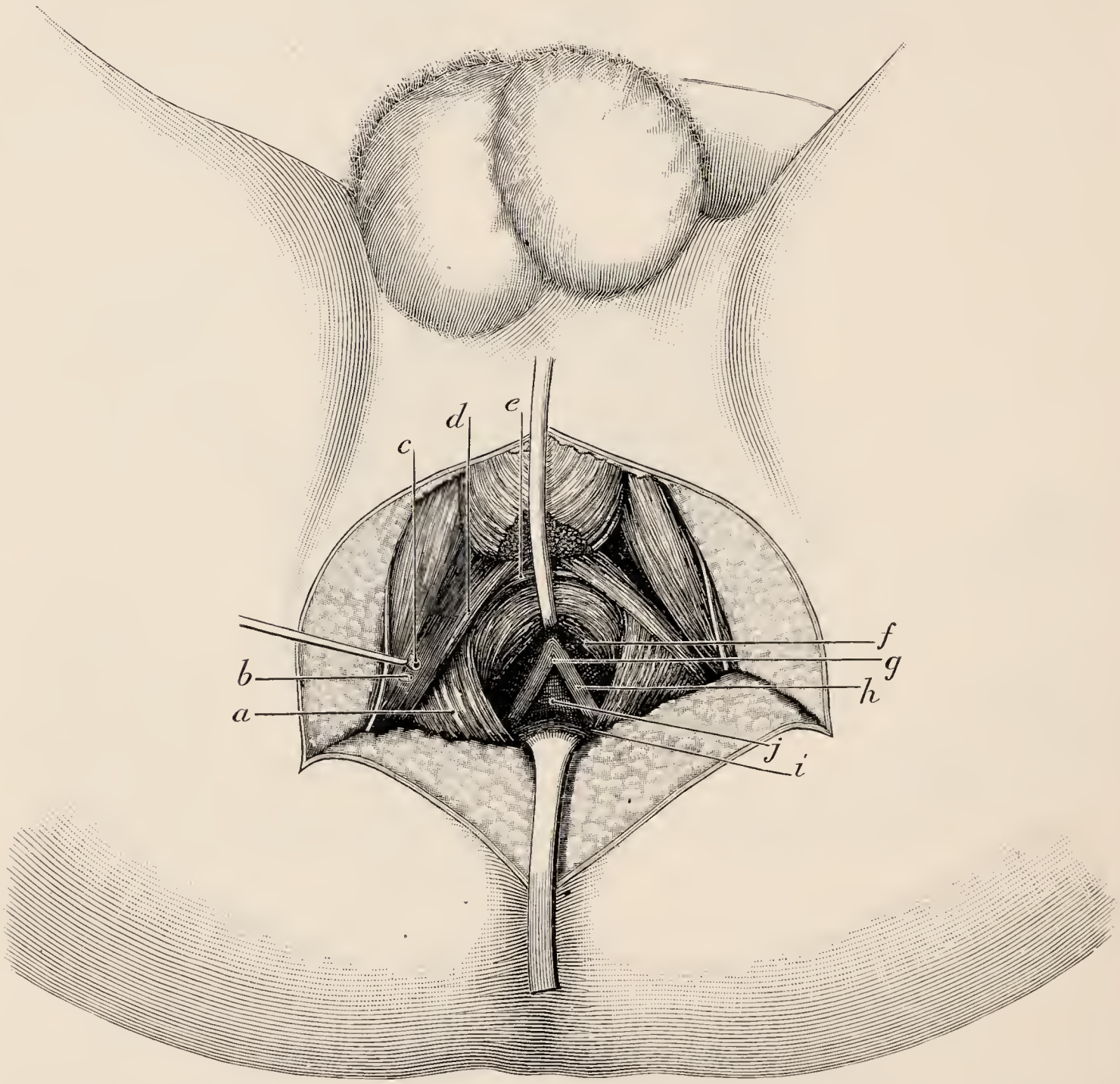



FIG. 1332.—Deep surgical anatomy of perinæum. *a*. Levator ani muscle. *b*. Internal pudic nerve. *c*. Internal pudic artery. *d*. Transversus perinei muscle. *e*. Fibers of compressor urethral muscle. *f*. Prostate body. *g*. Vas deferens. *h*. Vesicula seminalis. *i*. Rectum. *j*. Bladder.

(without removing the finger) with the cutting edge upward, a long, straight, narrow bistoury at the median line of the perinæum, three quarters of an inch in front of the anus, and thrust it upward to the abscess, guided by the fingers in the rectum; enlarge the incision upward sufficiently, on withdrawal of the knife, to afford free exit for pus; explore the cavity with an aseptic finger, breaking down abscess partitions when found; irrigate the wound with a hot saline solution, and arrest profuse deep hæmorrhage by packing.

In either instance the tube should be removed after a few days and gauze drainage only employed, allowing union by granulation.

*The Remarks.*—If pus be located with a needle, let it remain as a guide to puncture of the abscess. The depth of the pus from the surface will depend on the amount and extent of the suppuration, and the thickness of the perinæum. A depth of an inch or two at least may be expected. Avoid perforating the rectum or urethra in making the incision. Abscesses ought not to be opened into the rectum unless only the mucous membrane be interposed, then dilatation of the sphincter should follow at once. If the abscess have opened into the urethra, perineal section should be performed, prostatic urethra dilated, and the bladder drained for ten or twelve days, or until the abscess cavity is healed. The cavity of Retzius (Fig. 1378) can be drained through the perineal opening with gauze or small rubber tubes. Improperly drained prostatic abscess is complicated not infrequently with fatal phlebitis. Prostatic abscess sometimes opens into the ischio-rectal fossa (Fig. 1198), and is then difficult to heal, because of the numerous sinuses that complicate it.

*The Results.*—Wide-apart conclusions are reported as to the rate of mortality—from 3 to 30 per cent are given. In our opinion the former estimate is the more correct of the two. About 40 per cent of the deaths are due to prostatic phlebitis—a figure which may be regarded as a low estimate, indeed, for such a disease and its sequels.

*The seminal vesicles and vasa deferentia* can be reached through the convex incision (Fig. 1331), but with some difficulty because of its depth. *Rydygier's* osteoplastic flap in proctotomy (Fig. 1225) affords easy access, and free view on pushing aside the rectum and partially distending the bladder. *Dittel*, after passing a catheter and stuffing the rectum with gauze having a string attachment, placed the patient in the same position as for operation on the prostate, and exposed the seminal vesicles through a like incision (Fig. 1326). *Roux* attained the purpose well through a straight four-inch incision made an inch to the left of the median line of the perinæum.

**Extroversion of the Bladder.**—In extroversion of the bladder the anterior wall of the bladder and abdominal parietes are absent, while the posterior and inferior portion of the bladder protrudes through the opening in the abdominal wall on account of the pressure of the viscera behind it. Various measures have been attempted to establish a more feasible channel for the escape of urine, none of which, however, have afforded any practical benefit. *Simon* made an attempt to connect the ureters with the rectum, but with no practical success. *Floyd* and *Johnson* attempted to establish a fistulous communication between the bladder and rectum by means of setons, but the patient died shortly after from peritonitis. *Sonnenburg* extirpated the bladder (page 1156), united the ureters with the dorsal groove of the penis, and closed the abdominal wound with flaps; the outcome was more of a surgical than a practical triumph. The methods of autoplasty are the most rational, and have in many instances afforded substantial relief.

*The operative treatment* may be begun as early as four years of age, the sooner, within the reasoning limits of the patient, the better, as the

time employed in the cure may exceed a year or two. The patient's physical condition should be good, and the parts should not be disturbed by emotional causes. All evidences of local irritation should be subdued and irritating influences removed or ameliorated. The practice of the late Greig Smith bearing on a case of this kind is very important. He kept the patient on the back for fourteen days, hoping to diminish the size of the tumor by removal of the weight of abdominal contents. In order to exclude atmospheric or other sources of irritation, and limit the deposition of phosphates by the prevention of evaporation, he covered the mucous membrane of the deformity with oiled silk coated with dextrin and overlapped with a double layer of boric lint. Bland and demulcent drinks were freely given. He found that "under this treatment the surface of the extroverted mucous membrane soon became less red and angry looking, and latterly, over its upper half, as low down as the orifice of the ureters, it became covered with true epidermis almost as white as that of the surrounding skin. The mucopurulent discharges diminished considerably in amount, and the excavations in the contiguous skin entirely disappeared." The presence of hair on the reversed flaps provokes the deposit of phosphates, especially in the older patients. Therefore, the capillary growth should be destroyed with nitric acid or electricity before the utilization of the surface. However, in very young subjects depilatation is not needed, as the perversion of use seems to prevent the capillary growth.

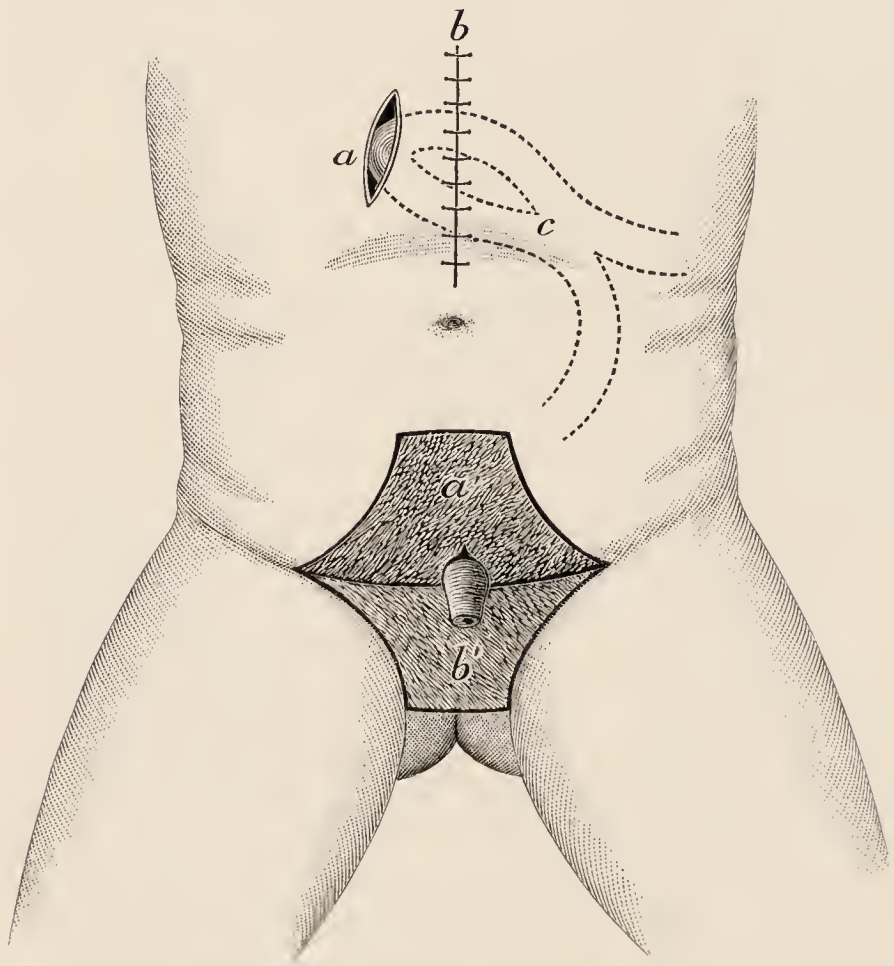



FIG. 1333.—Maury's operation for extroversion of bladder. *a'*. Reflected perineal flap. *b'*. Denuded surface. *a*, *b*, *c*. Jejunostomy, Albert's method (page 766).

**Maury's Method.**—Make a curvilinear incision on each side with the convexity upward, extending from the outer third of Poupart's ligament downward and inward below the scrotum to the perinæum, at which point they become joined by a short transverse incision (*b*, Fig. 1333). This flap is dissected upward over the scrotum to the root of the penis, which is then slipped through a valvelike incision made at the base of the flap, thus permitting the urine to escape without coming in contact with the raw surfaces above. A second or abdominal flap is now formed by carrying a transverse incision across the abdomen below the umbilicus and a curvilinear one around the defect, as in Bigelow's operation (*a*, *a*, *a*, Fig. 1334). A short circular flap is then formed by dissection of the borders of

the defect for about an inch. The lower flap (Fig. 1333, $a'$), is then turned upward to bring its cutaneous surface in contact with the mucous surface of the bladder. The cuticle around the borders is removed, so that the borders can be placed in contact and united with freshened surfaces. The borders of the lower flap are fashioned and beveled so as to slip under the circular

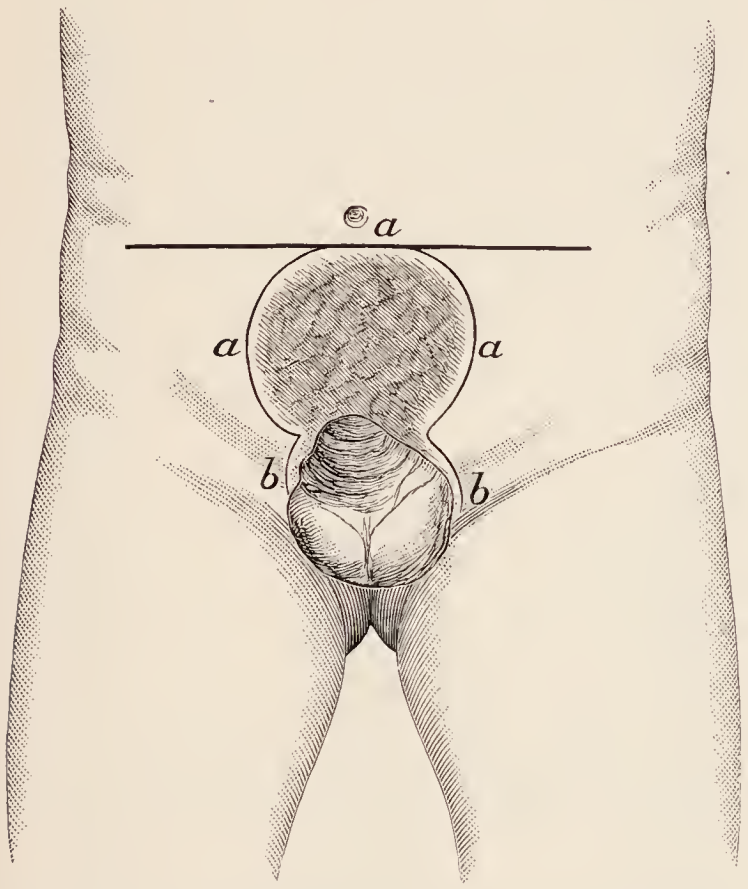



FIG. 1334.—Bigelow's operation for extroversion of bladder. $a, a, a$. Flap-dissected borders. $b, b$. Flaps from inguinal region.

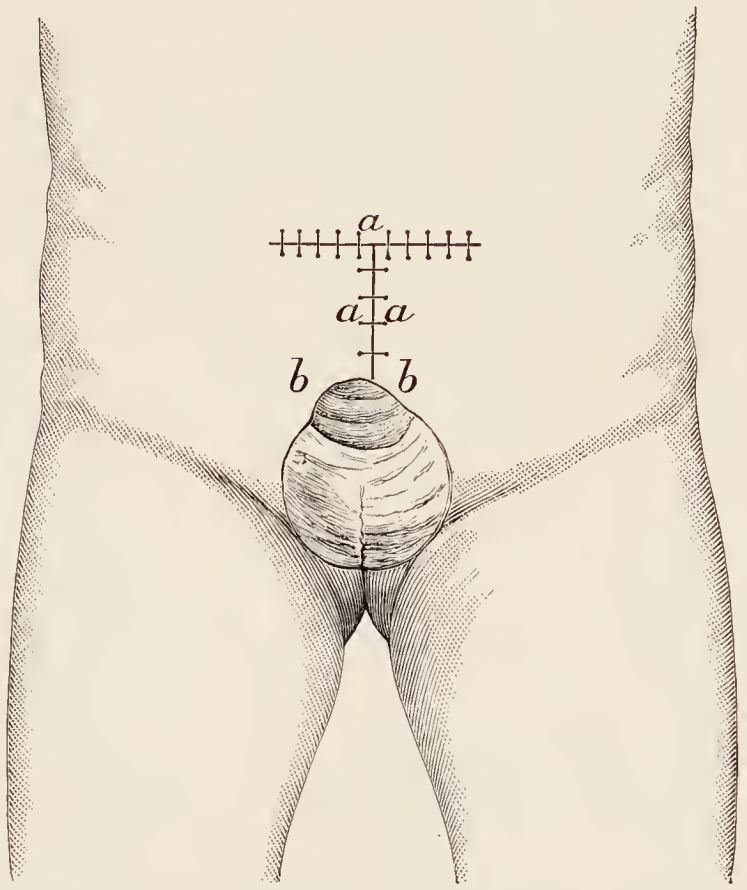



FIG. 1335.—Bigelow's operation for extroversion of bladder completed. $a, a, a$. Borders of incisions united. $b, b$. Inguinal flaps in place.

flap at the border of the defect, to which it is united by catgut or quilled sutures. This method offers good results in operations upon males. *Bigelow* dissected off the mucous membrane of the exposed bladder down to a line with the ureters (Fig. 1334), constructed lateral flaps from each inguinal region, united them in the median line and above (Fig. 1335), and thereby secured a perfect result. Skin grafting (page 513) can be employed in the healing of surfaces denuded for the purposes of repair.

**Wood's Method** (Fig. 1336).—Wood's method can be employed in both sexes, but is better adapted to the female. It consists in making a central or umbilical flap ($a$), after which a lateral flap is made from each groin ($b, c$), and carried inward over the previously everted central one and united in the median line to each other.

*The Operation.*—The central flap ($a$) is measured upward by a line extending at either side of the bladder from a point opposite the root of the penis to as far above the bladder as from the root of the penis to the upper margin of the bladder, and joining each other across the median line of the abdomen in a curved manner (Fig. 1336). The two lateral flaps ($b$, $c$) are made having rounded external borders, with their attachments downward and inward, corresponding to the base of the scrotum and large enough, when properly detached and turned inward, to meet in the median line

their entire length. Their upper limits correspond internally to the centers of the vertical incisions. The incision, completing the inner border of each flap, is carried from the lower end of the vertical incision already made along the side of the urethral groove for half its length. After proper separation of the flaps the central or umbilical flap is turned downward and stitched at either side to the cut edges of the root of the penis. The lateral flaps are carried inward over the umbilical flap, thus apposing the raw surfaces of the respective flaps to each other. The flaps, and the borders of the gaps resulting from their displacements, are united as indicated in the illustration (Fig. 1337), leaving the unclosed spaces to heal by granulation. The root of the penis should be closely embraced by the lateral flaps to prevent subsequent weakness and protrusion at this point. The integrity of the external pudic vessels will add much to the vitality of the lateral flaps.

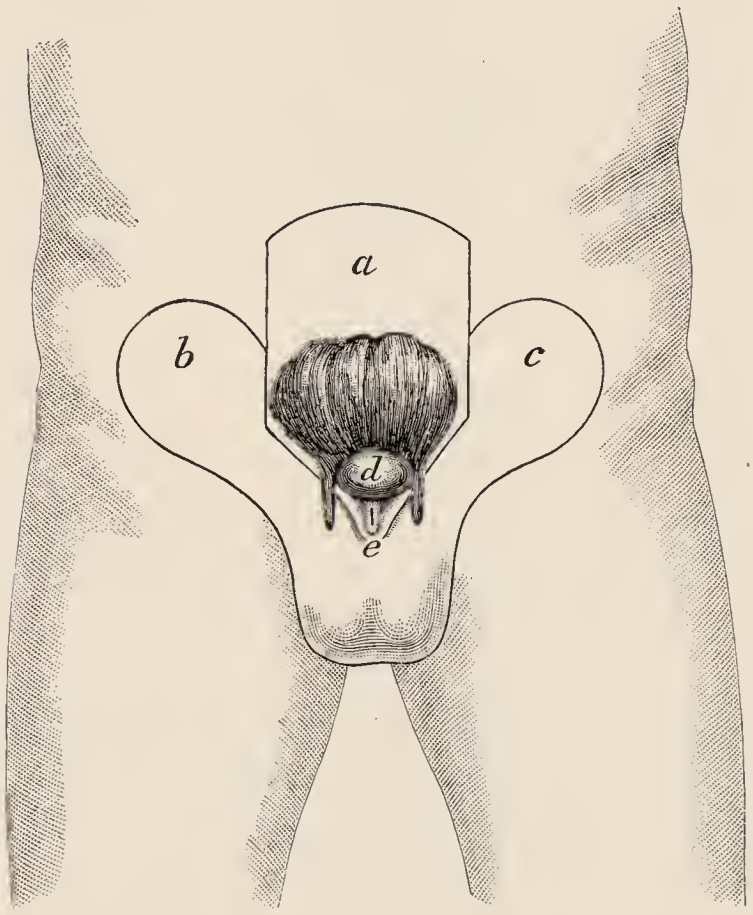



Fig. 1336.—Wood's operation for extroversion of bladder. *a*. Central flap. *b*, *c*. Lateral flaps.

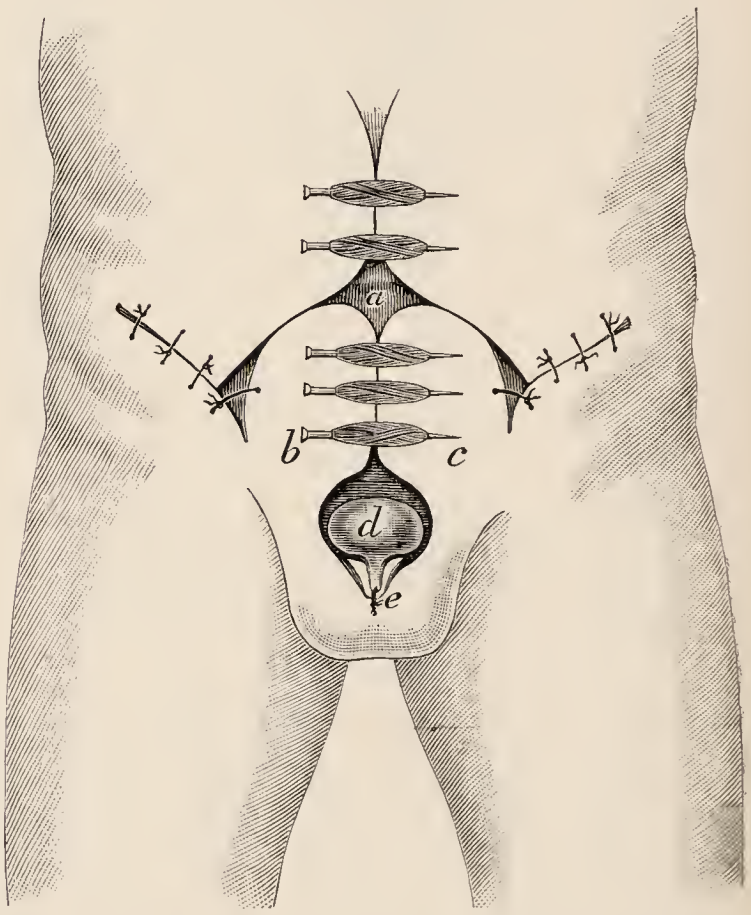



Fig. 1337.—Wood's operation for extroversion of bladder. *a*. Upper flap raw surface. *b*, *c*. Lateral flaps. *d*. Prostate body. *e*. Penis.

Aseptic precautions and careful handling of the flaps are important desiderata.

*The Comments.*—The flaps should be made of as nearly *uniform thickness as possible and not too thin*, as then they will slough. At the upper margin of the bladder the tissues are so thin that the peritonæum may be cut unless care be taken. Harelip sutures need not necessarily be employed.

*Modifications of Wood's Operation.*—*Robson* modified Wood's operation in a case of his own in the following manner: "A large square flap was taken from the abdominal wall above the umbilicus and turned downward so that the cutaneous surface came in contact with the exposed vesical mucous membrane (Fig. 1338). Pyriform flaps, one on each side, were taken from the lateral aspects of the abdomen and twisted inward on their attachments,

so that their raw surfaces came in contact with the raw surface of the first-mentioned square flap. When secured in position the flap entirely covered

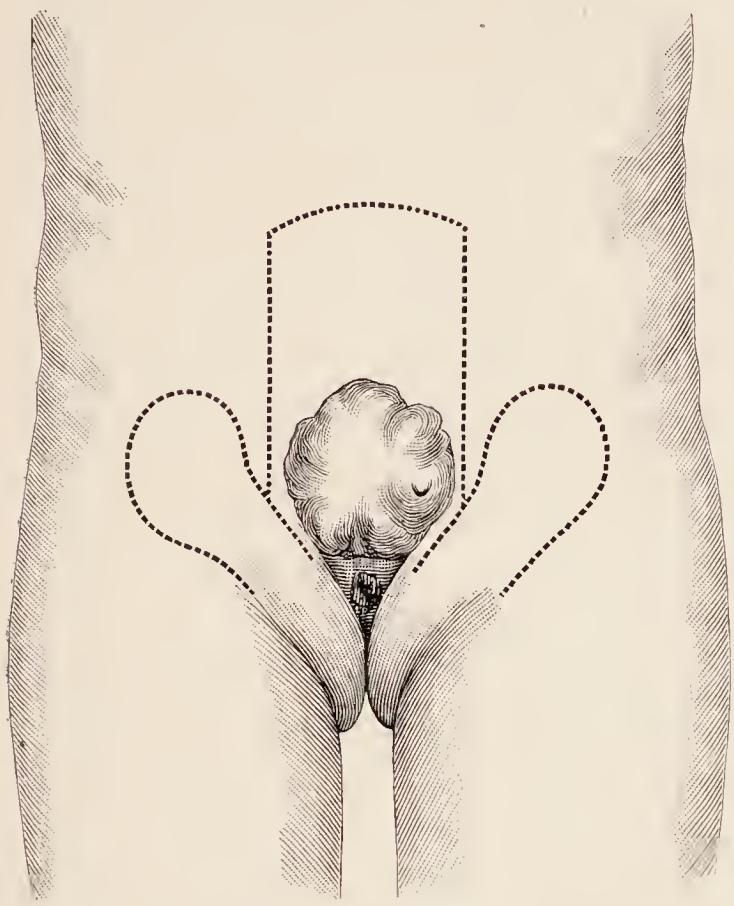


FIG. 1338.—Robson's modification of Wood's operation. Formation of the square and pyriform flaps.

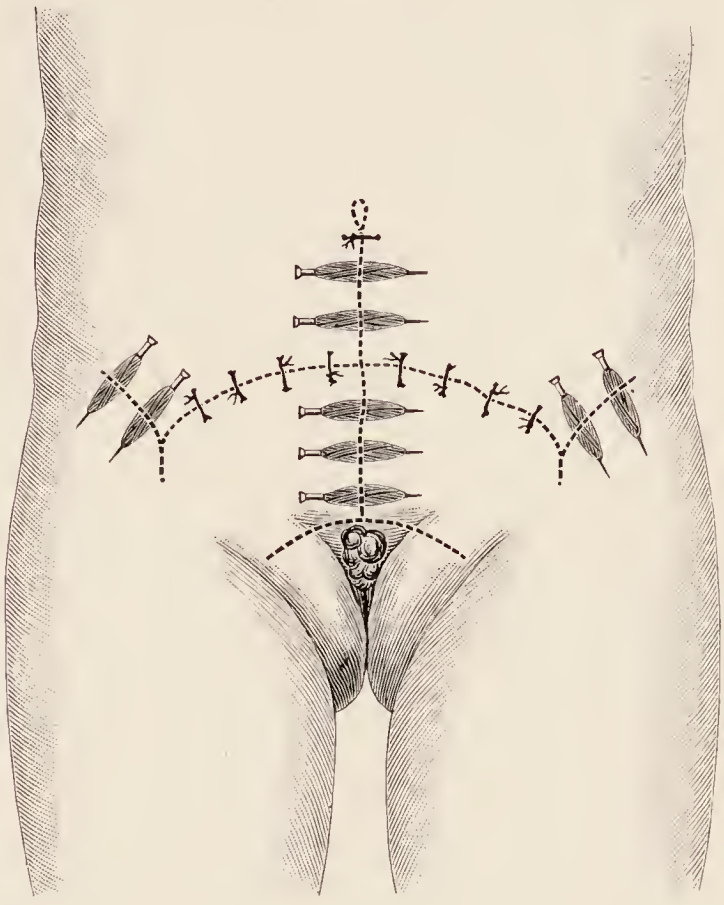


FIG. 1339.—Robson's modification of Wood's operation. Flaps placed in position and borders secured.

the vesical surface. The edges of the exposed surfaces on the abdomen were drawn together and secured by harelip pins and sutures" (Fig. 1339).

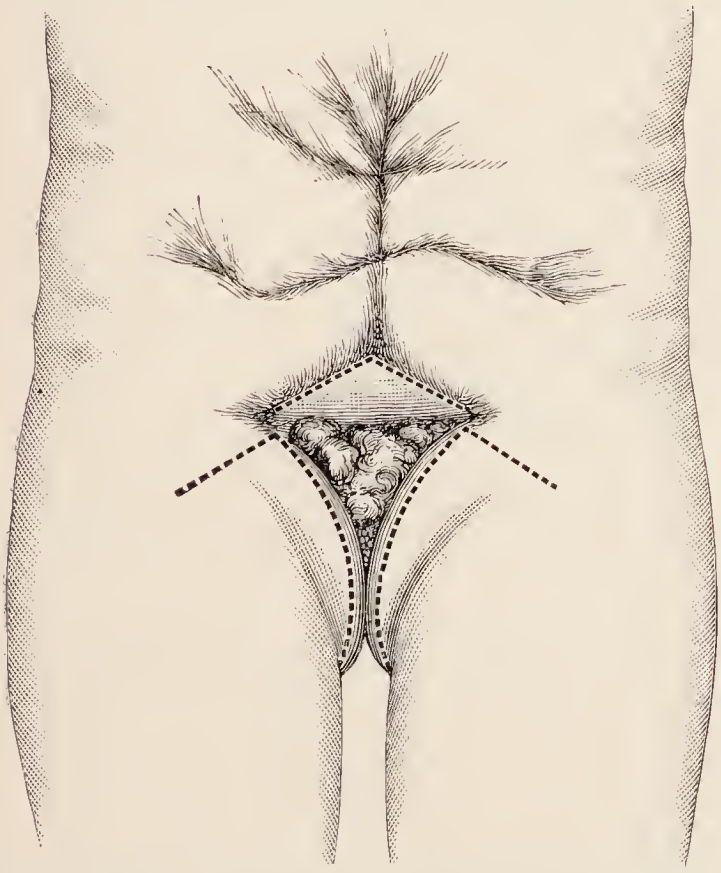


FIG. 1340.—Robson's modification of Wood's operation. Secondary operation to remedy effects of retraction.

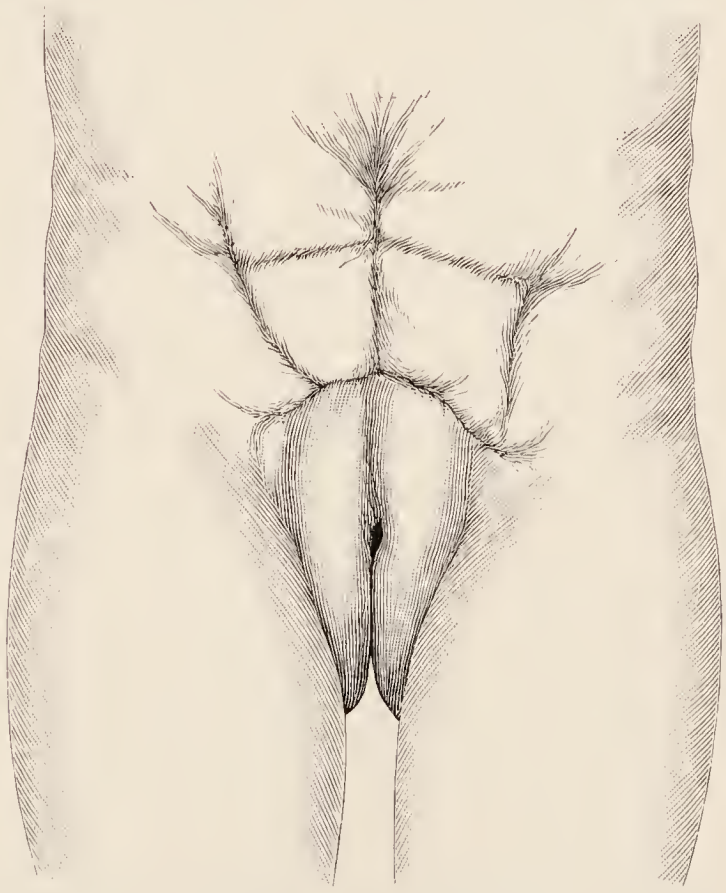


FIG. 1341.—Robson's modification of Wood's operation. Results of secondary operation.

The retraction incident to healing brought into view a part of the lower vesical surface. "To remedy this defect the prominent folds of the integu-

ment forming the labia majora were incised for three inches vertically, and from the upper ends of these cuts incisions were carried outward so as to allow two triangular flaps of skin to be carried upward (Fig. 1340). The square flap of skin was loosened at its attachment to the pyriform flaps, and turned downward so that the cutaneous surface again covered the bladder mucous membrane. The newly made groin flaps were approximated toward the middle line covering the raw surface, and secured in apposition for an inch and a half, while the upper margins were sutured to the newly refreshed lower margins of the pyriform flaps of the Wood operation" (Fig. 1341).

*Greig Smith* formed the flaps a little larger than Wood did, and shaped the umbilical one to conform to the shape of the wooden portion of an ordinary bellows, the handle to which was located above and in the median line, and when turned down and united to tissues raised from the penis and scrotum repaired the defective urethra. Quilled sutures were employed to unite the flaps.

**Thiersch's Method.**—Form successively two lateral flaps, each large enough at the time of the making to cover the entire defect. Begin the first flap by making an incision from the upper margin of the defect downward along its border to the root of the penis; begin the second incision the width of the defect to the outer side of the commencement of the first, and carry it down parallel with the first to Poupart's ligament; detach the flap between the extremities, leaving the latter undivided; place beneath the flap tin foil for three weeks while awaiting granulation; freshen the margin of the lower portion of the defect, and divide the flap at the upper end; turn the flap downward so as to cover the lower part of the defect and attach it to the border of the freshened margin, with the cutaneous surface upward; freshen and unite the end of the flap with the contiguous freshened border of the defect after the former is securely fixed in place. After the first flap becomes firmly attached, make the second of the same dimensions as the first and correspondingly located, except that the lower limit should conform to the upper border of the first one. Treat the second in a like manner as the first for a similar time, and then repair the upper part of the defect with the second flap in the same manner as the lower part was repaired by the first. After a secure union of the second flap, unite with each other the contiguous borders of the two, and also the upper border of the second, with the freshened upper margin of the deformity. Repair the urethral deformity at a later period.

*The Remarks.*—By this method a thin, illy-nourished umbilical flap and the dangers attending its construction are avoided, and, instead, flaps with established vitality are employed.

*Modifications of Thiersch's Method.*—When it is impossible to close entirely the defect by Thiersch's method, *Segond* recommends that a smaller bladder be formed in the following manner: After freshening the borders of the penile furrow, form a new vesical cavity with the material of the old by an extraperitoneal dissection downward of the mucous membrane of the bladder. The mucous flap is turned forward and downward and sutured to the freshened penile furrow. Then make an incision through the prepuce,

dissect it up, draw it over the glans penis, and its raw surface, with that of the lateral abdominal flaps, is employed to cover the mucous membrane limiting the newly formed bladder.

*The Remarks.*—The difficulty of dissecting away the mucous membrane without impairing its integrity, or implicating the peritoneal cavity, is the chief objection to this operation. The base of the mucous flap corresponds to a point just above the attachment of the ureters to the muscular wall of the bladder.

*Pousson*, with the idea of avoiding the objectionable features just stated, made a flap of the exstrophied bladder by carrying an incision around its border into the peritoneal cavity. This flap is utilized in repair the same as the mucous flap, and the consequent defect in the abdominal wall is closed by direct suture.

*Billroth*, in 1881, expressed himself as follows: "At first I used to cover over the extroversion by paring and uniting the abdominal walls after previously detaching the bladder from them. Then for a while I tried making two lateral pedunculated flaps from the abdominal wall. Now I have come to the conclusion that the best method is to dissect up two broad, lateral, doubly pedunculated flaps, whose narrow parts lie above and below. After ten or fourteen days, when the under surface is granulating well, I unite the two in the middle line without cutting through the peduncles. If the flaps be sufficiently broad, there is no need to unite them by their outer edges; these lateral openings close spontaneously in from five to six weeks. The bladder is thus completely covered in, but an opening should be left at the umbilicus through which the urine may escape until the urethra below is completely formed; then the umbilical opening is closed, and it heals up as the urine escapes below by the newly formed passage.

"The flaps must be made very broad—that is to say, in an adult they should be at least six centimetres broad in the middle and about five at the upper and lower parts; in a child, of course, they should be somewhat, but still not so very much smaller. The flaps should be so completely detached as to overlap each other for about half their width; a sheet of tin foil is then laid underneath them in their whole length. In a few days they approximate so much that their curved shape becomes straight; later on, notwithstanding a certain amount of rigidity, they will readily unite in the middle line. A broad surface must be made by scraping away the granulations and the superficial developing epidermis from the edges. At first I suspected that this median cicatrix might possibly give way as the bladder was pressed forward, so that a sort of vesical hernia might form, as happens occasionally under similar conditions after laparotomy. I have, however, a case under observation which was cured five years ago, and which satisfactorily proves that such a fear is groundless.

"The wounds of the abdominal wall, after the formation of flaps on both sides, are of rather formidable size. The hæmorrhage can easily be controlled. If the flaps be made too small, a strip of the tissues either about the center or above it is apt to slough. Such an occurrence will seriously depreciate

the result. A further disadvantage of making the flaps too small is that lateral openings will be left, which are very difficult to close."

**The approximation of the innominate bones** as an element of cure in this deformity has attracted considerable notice and given rise to many ingenious conceptions of repair. The presence of a gap of two inches or more between the pubic bones in exstrophy of the bladder has long been recognized, and the possibility of closing the gap considered. Trendelenburg regards five years of age as the best period for operation, and practices the following plan of action :

**Trendelenburg's Method.**—Note the degree of separation of the bones in front, and, under aseptic precautions, expose and divide the posterior sacro-sciatic, interosseous, and superior ligaments of the articulation ; freshen and approximate the pubic bones so as to close the gap ; close and drain the posterior wound, and apply suitable dressings and a retention band. The use of transverse traction (Makins), of elastic extension, or an extension by weights applied to each of the crossed ends of a pelvic band, will hold the pubic bones in contact. It is hardly necessary to say that defilement of the point of juncture will delay union, and may develop unfortunate inflammatory complications.

*The Remarks.*—This operation is better adapted to the male than the female sex, owing to the objectionable narrowing of the pelvis in the latter sex. The anterior iliac spines are the bony points for estimating the degree of approximation, and although easy closure of the vesical defect is gained, an absolute value can not yet be placed on the operation.

*König* and *Küster* substituted for the sacro-iliac separation osteotomy of the pelvic ring. *Passavant* proposed closure by " brisement forcé " under anæsthesia. Later operators regard with disfavor all of these attempts, because of the primary and secondary dangers attending them, and also the fickleness of the results. The various transplantations of the ureters into the rectum, colon, etc., with the view of relieving the patient of the almost insufferable nuisance of the dribbling urine, are considered under The Surgery of the Ureters (page 850 *et seq.*). *Harrison* removed one kidney, waited until the remaining kidney had undergone compensative hypertrophy, then transplanted its ureter into the groin and collected the urine with a suitable apparatus. The change of condition brought about by this course of action afforded the patient great relief. Repair of the bladder by transference to the defect of intestine has been practiced. The resection of the trigone so as to include the ureters, and its transference to the sigmoid flexure of the colon (Maydl), followed by removal of the bladder, has been practiced with remarkable success. *Lewis* reports seventeen cases, with two deaths, one from shock, the other from infection. One case died after four months from pyonephrosis. " Urinary continence was perfect in all of the cases excepting two." The urine could be held from three to seven hours, and in one instance the entire night. The tolerance of the rectum permitted the urine to appear with or without fæcal matter, as the condition demanded.

*The after-treatment* is somewhat perplexing, because of the necessity to place the patient and protect the bed so as to prevent objectionable contami-

nation of either with urinary discharges. *Parker* placed his patients in a warm hip bath of a boric-acid solution for days after the operation, with comfort and reparative advantage to the part. Of course, the bath should be maintained at a comfortable temperature, and frequently changed to preserve the requisite degree of cleanliness. Various other measures directed to a like purpose are carried into effect.

*The Results.*—Control of the bladder while in an erect position is rarely secured by operation; this need is ameliorated by the use of the rubber urinal. However, the urine is often under quite good control in the recumbent posture. The death rate is from 20 to 30 per cent, depending upon the character of the efforts employed.

*Pousson* reports 52 cases, of which 4 died from the operation; in each of these Trendelenburg's method had been practiced.

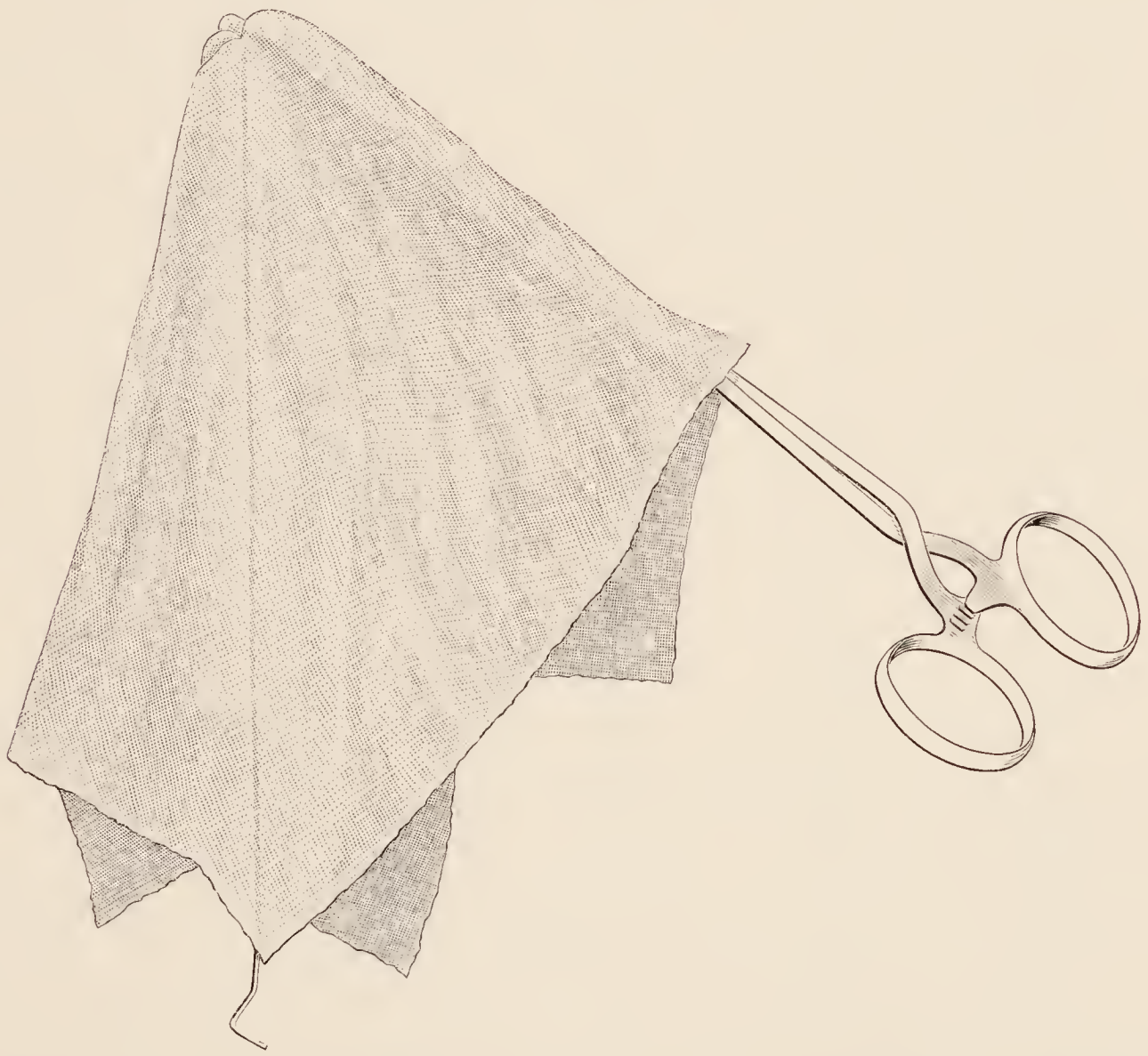


FIG. 1342.—Mikulicz's tampon for arrest of severe oozing in deep cavities. Forceps grasping apex of tampon at the top of investing fabric. String employed in removal tied to apex.

*Segond's* plan appears to afford excellent results, being satisfactory in the 10 cases in which it has been employed. The cause of death often arises from ascending infection of the kidney, provoked by an excess of surgical attempt and a lack of surgical care.

**Extirpation of the Bladder.**—*Partial* and *complete extirpation* of the bladder are practiced; the former (page 1122) for removal of limited growths and the latter for the extensive ones and for congenital defects.

*Küster* practiced complete removal of the bladder as follows: After thoroughly shaving and cleansing the parts the patient was placed in the Trendelenburg posture, the bladder exposed above the brim of the symphysis pubis, the brim of the pelvis chiseled away, the fragments remaining attached to the muscular insertions above, and the bladder opened for the purposes of inspection. After thorough observation of the interior the opening in the organ was sewed tight and the viscus itself freed by blunt dissection from its surroundings. An incision was made in the median line of the perinæum, the urethra divided transversely, the prostate body grasped with the fingers and liberated by blunt dissection with scissors and fingers. The incision into the bladder was reopened to permit of the localization and exposure of the ureters, which were then tied with silk and severed obliquely from in front backward and upward. The remaining connections of the bladder were severed with scissors, the organ was removed, and the ureters were implanted into the rectum. After thorough cleansing the wound was closed by restoring and wiring in place the fragments of bone and uniting the soft parts in the usual manner.

*The Remarks.*—Openings made into the peritoneal cavity during the operation should be at once closed. The hæmorrhage should be thoroughly arrested before the wound is finally closed, even if the use of a tampon (Fig. 1342) be required, as may happen if malignant involvement be unexpectedly extensive. Thorough drainage should be secured. If the ureters be implanted in the bowel and the bladder left *in situ*, the organ may rapidly shrink and become a round, hard, and indifferent body. The substitution in any manner for the bladder of an intestinal loop does not afford the bright outlook that has characterized the successful efforts of Maydl and his followers.

## STONE IN THE BLADDER.

Stone in the bladder is quite common, and usually is accompanied by well-marked and characteristic symptoms. Sometimes, however, calculi of inordinate size and with unusual asperities are attended by only trifling manifestations.

*The Detection of Stone in the Bladder.*—When it is suspected that a stone may be in the bladder the proof of its presence is sought by a searcher, by bimanual palpation, and the use of a cystoscope. The lithotrite, the evacuator, and the ordinary sound can be used for the purpose, but not with the technical skill and surgical justification that belong to the use of the first three means of exploration. There are various patterns of searchers (Figs. 1343, 1344, and 1345). The one devised by Thompson is most commonly employed. It can be used for the double purpose of regulating the amount of water in the bladder by injection or by outflow, thereby better accommodating the bladder walls to the main object of the use of the instrument—sounding for stone.

*The time of sounding for stone* should be when the patient is suffering the least from the bladder difficulty. If the patient be a child an anæsthetic should be given, if an adult only when he is extremely restless from the

pain. Two or three ounces of a two-per-cent solution of cocain have been employed successfully in the bladder to relieve the pain and irritation of sounding. The urine of one or two hours' secretion should be allowed to collect in the bladder, or its equivalent, four or five ounces of warm sterilized water, should be injected before attempting the act. Not infrequently it is wise to distend the bladder with aseptic fluid before sounding, so that the characteristics of the stone and the bladder can be the better estimated by allowing the fluid to slowly escape during the explorative manipulations.

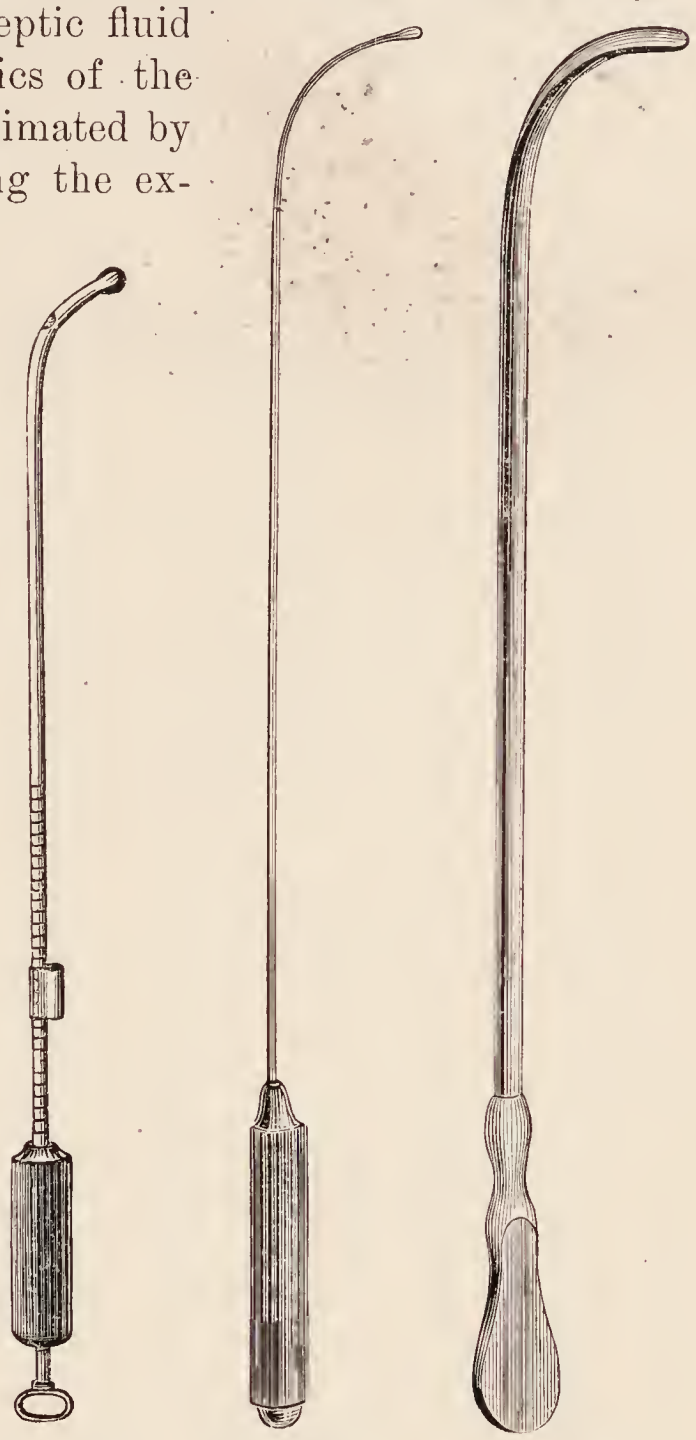


Fig. 1343. Thompson's searcher. Fig. 1344. Little's searcher. Fig. 1345. Gouley's searcher.

*The Operation of Sounding.*—Place the patient on the back with the hips raised, the operator standing upon the right side. Introduce the searcher in substantially the same manner as employed in the introduction of a catheter or sound (page 1109); push the instrument carefully to the posterior wall of the bladder, with the beak upward; withdraw it slightly to give easy play to the vesical end, and then carefully turn the beak from side to side until the lateral walls of the bladder are touched by it. This is done by rotating the instrument on its long axis between the thumb and finger. Turn the beak downward and examine the base of the bladder. In this manner the whole inner surface of the bladder is examined, the instrument being withdrawn each time a sufficient distance to accomplish the object thoroughly. As soon as the beak comes in contact with the neck of the bladder the instrument may be withdrawn. If the prostate be enlarged, the handle should be depressed and the beak turned toward the floor of the bladder and rotated from side to side while being gradually withdrawn. This manœuvre will be quite sure to detect a stone if it be lodged behind the prostate.

If a stone be not detected, it is better to make a second and even a third examination before positively asserting that none is present. Five or ten minutes is quite sufficient time to employ at a sitting. If the presence of stone be detected, the number, size, and the probable consistence should be determined. The presence of two and even three calculi can be reasonably estimated by careful manipulation with the searcher. However, this knowledge is best gained by the use of the lithotrite. If a stone be grasped by this instrument the presence also of one at either side of the beak can be

determined with reasonable certainty by the alternating "clicks" attending the turning of the beak from side to side. The size of the stone can be estimated approximately with a searcher by noting the extent of the area of friction and distance of the exposure of the shaft of the instrument at the meatus when the beak is applied alternately to the anterior and posterior surfaces of the calculus. The dimensions of the object grasped by a lithotrite can be accurately determined. The distinctness of the click will indicate

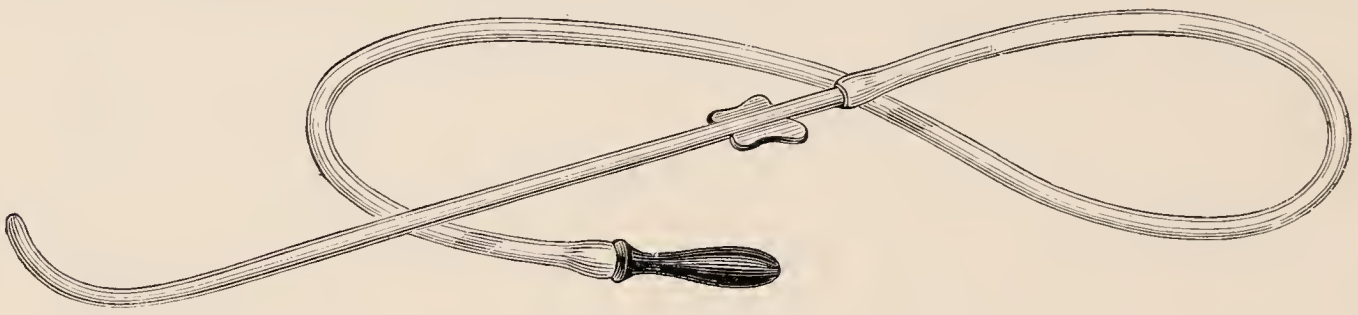


FIG. 1346.—Andrew's searcher, with a tube to convey the sound to the ear.

the hardness of the stone as a rule. A pasty stone will give a soft, low-pitched sound; the reverse will follow contact with a hard one. A hard stone surrounded with organic matter may be mistaken for a soft one. After the searching is completed apply warmth to the hypogastrium, give an anodyne and possibly ten grains of quinine, and keep the patient quiet.

*The Comments.*—The ability to detect the "click" of small stones and fragments by aid of the searcher is greatly enhanced by the attachment of the so-called "lithophone." This attachment can be extemporized by taking a piece of rubber tubing, twenty-five or thirty inches in length with an eighth of an inch caliber; double one end upon itself and place it against the handle of the searcher, allowing also the tubing continuous with it to lie along the handle, or push it into the open end of the handle of the searcher. The other extremity is then placed in the ear directly, or connected to it by the medium of an otoscope (Fig. 1346). The ability to detect fragments of an almost infinitesimal size is said to be thus attained (Fig. 1347). The washing process of litholapaxy will also cause the "click," when other measures have failed.

*The Fallacies.*—The fallacies of sounding

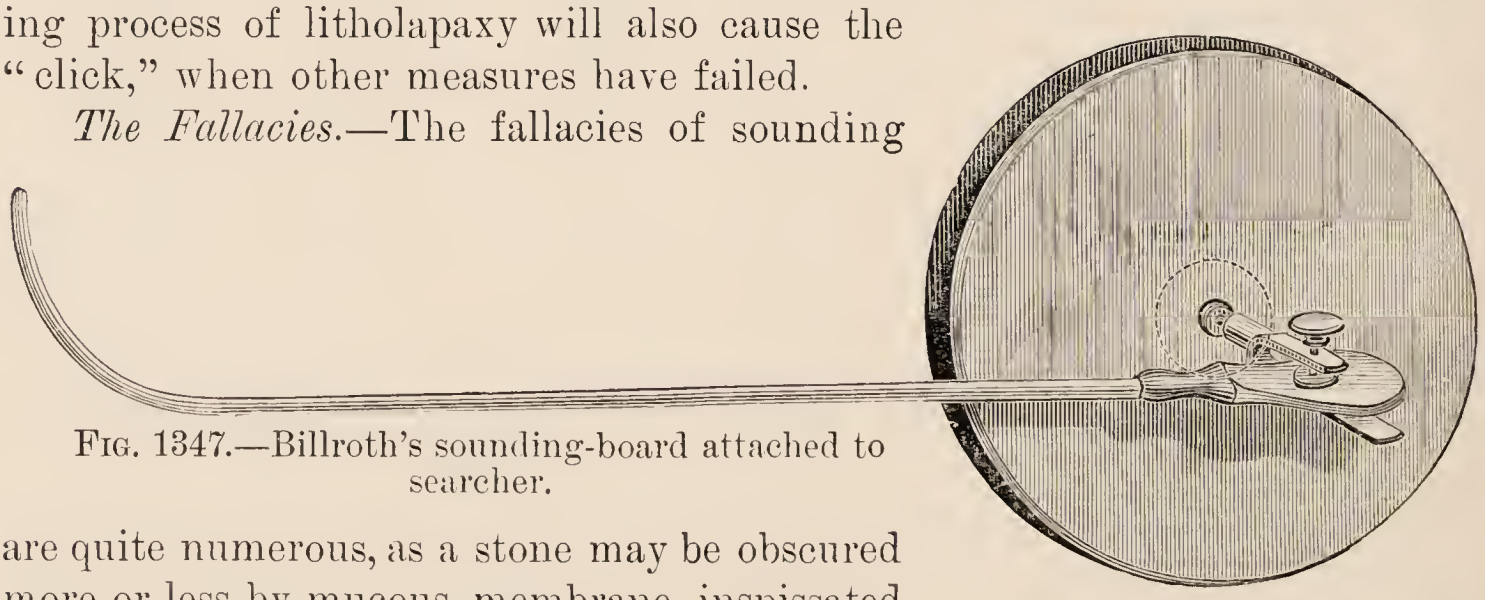


FIG. 1347.—Billroth's sounding-board attached to searcher.

are quite numerous, as a stone may be obscured more or less by mucous membrane, inspissated mucus, or blood, and when pocketed in an adventitious place. Calcareous incrustations connected with the wall of the bladder, or with a morbid growth, are sometimes mistaken for calculi. Finally, the instrument may not enter the bladder at all, and thus completely deceive the examiner.

**Bimanual Palpation.**—Bimanual palpation can be practiced in either sex with satisfactory results if the patient is not of an unusual muscular or adi-

pose development. In the male the patient is placed usually on the back, with the thighs flexed and the shoulders raised so as to relax the abdominal wall. The examiner introduces the index finger of the right hand into the rectum of the patient, and presses the tips of the fingers of the left behind the pubes and the bladder. Between the apposing finger tips an empty bladder can be so thoroughly examined as to detect in it the presence of a calculus of small size. Any undue pain or mental trepidation incident to the act can be relieved by general or local anæsthe-

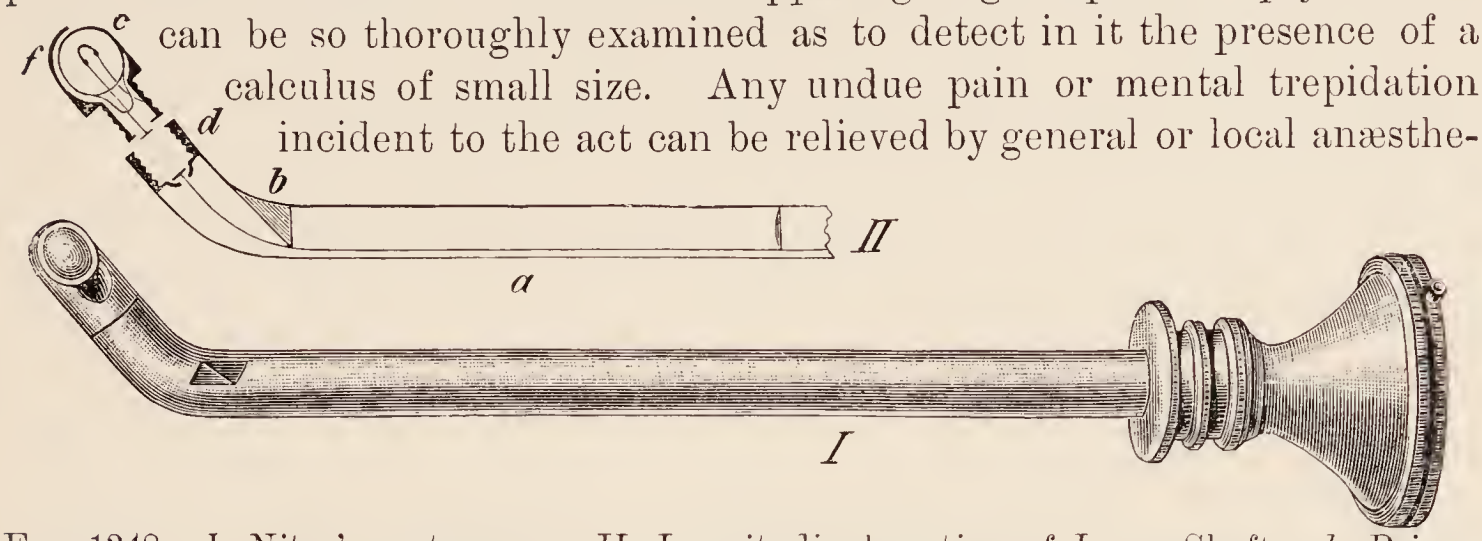



Fig. 1348.—I. Nitze's cystoscope. II. Longitudinal section of I. *a*. Shaft. *b*. Prism. *c*. Incandescent light which is fastened into the small compartment *f*.

sia if the importance of the condition justifies the use. In the female the manipulation is easier and even more conclusive, on account of the absence of the prostate and the intimate relations of the base of the bladder and vagina. In either sex the rectum should be thoroughly evacuated before the examination is begun.

**The Cystoscope.**—The use of the cystoscope is often advantageous in the determination of morbid conditions of the kidney or the cavity of the bladder,

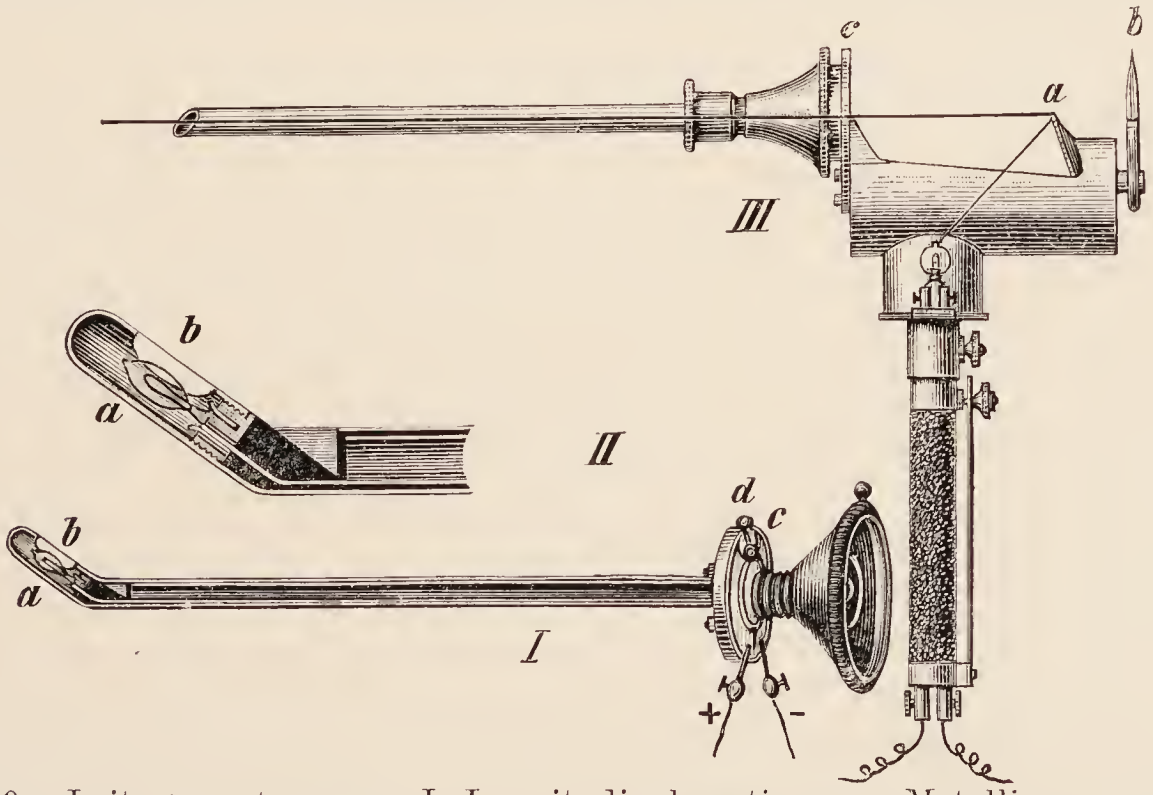



Fig. 1349.—Leiter's cystoscope. I. Longitudinal section. *a*. Metallic compartment and electric light. *b*. Depression for the window. *d*. Mechanism for closing the current. II. The same on a large scale. III. Electro-endoscope for illumination of the external auditory meatus, the œsophagus, and the urethra. *a*. Obliquely placed concave mirror which reflects the rays from the incandescent light in the tip of the instrument into the opening of the tube at *c*. *b*. Correcting lens for persons with myopia and hypermetropia.

and the interpretation of the functional phenomena of these organs (Figs. 1348 and 1349). A detailed description will not be given of the various

cystoscopes, as the continual improvements and the extending scope of the usefulness of the instruments forbid a commendation that may soon be of less comparative worth than that which the occasion affords. However, certain established facts regarding the use will not be amiss at this time. 1. The employment of the instrument should be conducted with a strict antiseptic regard in all respects, the same as in other operative procedures on the urethra and bladder. 2. A sufficiently capacious urethra and the presence in the bladder of not less than five or six ounces of clear fluid are always needed. If the urethra be too small it should be dilated gradually and continuously with bougies until sufficient caliber is secured. If the urine be clear the substitution of another fluid is not indicated. If it be cloudy the cavity of the bladder should be washed out with a boric-acid solution (three per cent), or solution of acetate of lead (one grain to the ounce), or with sterilized water, until the outflow is clear. The presence of blood, pus, or mucus interferes with a cystoscopic examination. The lithotomy position of the patient, with the examiner sitting or standing between the limbs, affords the best opportunity for examination. Either cocain anæsthesia of the urethra and bladder or general anæsthesia can be employed, as circumstances require and the patient's condition will permit. The light should not be turned on until the instrument is introduced into the bladder and the end immersed in the fluid to prevent burning the tissue, and for the same reason the end of the instrument should not be brought in contact with the wall of the bladder during operation. Extended experience is required to properly interpret the appearances and employ the instrument with facility.

Lithotrity, litholapaxy, and lithotomy are the practical methods of relief from stone in the male.

**Lithotrity** is the reduction of stone to fragments so small as to allow of their easy escape through the urethra with the urine.

*The Contra-indications.*—The contra-indications to lithotrity and litholapaxy are essentially similar. These operations are not admissible if the bladder be sacculated and affected with extensive cystitis, or if it be ulcerated or intolerant of the presence of instruments. Repeated and severe chills following the introduction of instruments into the urethra or bladder contra-indicate the operation. If the organ contain morbid growths, or if the patient be feeble, especially if the stone be large and hard and complicated with severe cystitis, crushing should not be attempted. In the instance of an enlarged prostate, lithotrity seldom affords prompt or even final relief, and the enlargement may be so great as to prevent proper litholapaxy.

*The Preparation of the Patient.*—It is wise in all cases, although not necessary in many, that the patient rest in bed for two or three days, and that the bladder be washed out with an antiseptic solution during the time before operation. In cases complicated with cystitis, with or without more extended disease, this course of action is essential. Bland food and diluents are always in order and should be supplemented with iron, strychnin, etc., when the vital forces are depressed. The bowels should be evacuated thoroughly, and the urethra dilated to the proper capacity for safe instru-

mentation by sounds. The patient is required to hold the urine for an hour or two, and is then placed upon the back with the pelvis elevated ; the older the patient the greater the elevation should be. An anæsthetic may be given and should be administered if it be the intention to triturate the entire mass at one sitting, or if the patient be irritable, or the bladder oversensitive.

*The Introduction of the Lithotrite.*—The operator, having chosen and well oiled a suitable instrument, stands upon the right side of the patient, taking the penis in the left hand, inserts the beak, and draws the member upward upon the instrument, which is tightly grasped by the right hand. The handle is then slowly raised until the shaft becomes vertical, when it is transferred to the left hand, and the fingers of the right are placed on the perinæum to follow the angle of the beak as it advances (Fig. 1350). The weight of the instrument will cause it to sink low enough to permit the beak to engage the opening of the triangular ligament, through which the urethra passes. A little careful manipulation, aided by the right hand on the perinæum, will cause it to enter this portion of the canal, when the handle of the instrument should be taken by the right hand and allowed to fall slowly of its own weight between the thighs. If the instrument be now slightly pressed upward, its upper extremity will be found to be disengaged and can be easily rotated upon its long axis.

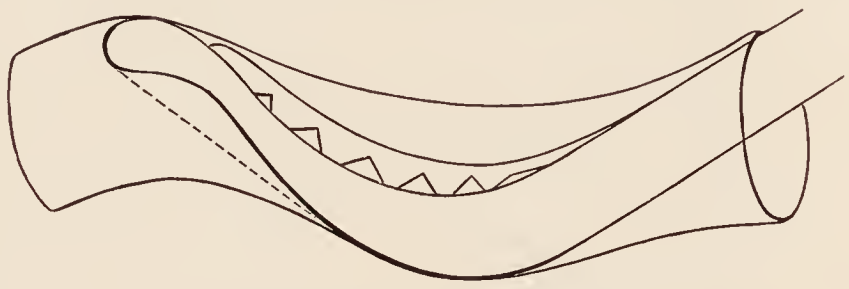


Fig. 1350.—Diagram of urethra with blade of lithotrite within it.

*The Comments.*—If the prostate be enlarged the length of the deepest portion of the urethra is increased, and the enlargement interposes an obstacle to the progress of the instrument. The handle should not, therefore, be depressed so rapidly during the latter stage, and the instrument should be pushed farther upward. Under no consideration should any undue force be used. The weight of the handle is of itself sufficient, unless under proper control, to cause laceration of the soft urethral tissues by the advancing end of the instrument. In the healthy bladder the instrument slides easily along the floor to the posterior aspect, often hitting the stone in the passage. In the instance of an enlarged prostate the entry is not so easy, and the stone is often hidden behind it.

*The Finding and Seizing of the Stone.*—The instrument is pressed upward in the line of its entrance until it reaches the posterior wall of the bladder, unless its course be sooner interrupted by the stone, when the beak is turned from the stone and the male blade withdrawn ; then the separated blades are turned toward the stone, which is seized and fixed.

If the stone be not detected during the introduction of the lithotrite, quiet is maintained for a few moments after the arrest of the instrument at the posterior wall of the bladder. Then the male blade is slowly withdrawn, with the beak upward, until quietly arrested by the neck of the bladder. It is then slowly returned to the former position, usually catching the stone

*en route.* If the stone be not found at this time, withdraw the male blade as before, and with the beak at 45° to the right, close the blades again. Failing in this attempt, separate the blades and turn the beak to the left to 45° and close the instrument. If this manipulation fail, depress the handle of the instrument so as to raise the beak slightly from the floor of the bladder, and turn it to the right and left respectively, as need be, opening and closing the blades in each position in the same cautious manner. If the stone be small or the prostate be enlarged, the beak should be turned downward in the search. This is readily done by depressing the handle of the instrument sufficiently to permit the reversed blade to sweep the floor of the bladder easily, without injuring the parts. The blades are then opened and closed at the various inferior aspects of the bladder, and in the same cautious manner as before.

Another manœuvre, which, in the case of small stones located behind the prostate, will often prove successful, consists in drawing the reversed beak outward until it nearly touches the prostate, and then separating the blades by pressing the female blade backward until it strikes against the posterior wall of the bladder, the male blade being held firmly in position; raise the handle until the female blade rests lightly upon the floor of the bladder, then draw it forward to join the male blade, lightly touching the floor in its course. If a stone lies in the line it will be touched, and, moreover, the mucous membrane will not be pinched. It is better that the blades be smooth and the beak be short in these reversed movements.

*The Comments.*—The movements of the instrument in searching should be slow, and punctuated with slight intervals, so that the stone will be disturbed as little as possible by contact or the agitation of the surrounding fluids. Usually the female blade is held firmly in position, while the male blade is opened and closed carefully for the purposes of finding and seizing the stone. A gentle tap of the handle of the instrument with the finger will sometimes cause a stone to fall within the grasp of the open blades. If practicable, the calculus should be crushed so fine at the first sitting as to prevent lodgment in the urethra of an impassable fragment. Forcible instrumental impingement on the neck of the bladder should be cautiously avoided at all times. Occasionally the stone may be so pressed against the neck of the bladder by the male blade as to prevent its being caught, unless the blade be turned to one side and cautiously insinuated between the stone and the organ. The brief though sage advice of Sir Henry Thompson, "Open; pause; close—that is all," establishes the safety of the procedure when cautiously practiced.

*The crushing of the stone* follows promptly the catching. The stone should be caught lightly and the blades be slowly fixed upon it to avoid its escape from the grasp in case it be hard or insecurely caught, as may happen if haste or vigor be exercised in such instances. When securely seized its dimensions should be noted, the beak turned upward and carried to the center of the bladder, as nearly as practicable, before crushing, in order that freedom of the mucous membrane be assured and that the fragments fall in a handy place for subsequent treatment with the least injury to the blad-

der wall. If the stone be soft the pressure of a steady turn of the screw is sufficient; if hard, a quick vigorous turn may be needed to crush it. In either instance, if quietly done, the fragments fall and lie close at hand, and can be caught and crushed by repeated opening and closing of the blades with the same deliberate care and manipulation that characterized the primary act. That is, the male blade should be withdrawn with the beak upward and axis of the instrument unchanged, then turned to the right or left and carefully closed, when, if a fragment be caught, the beak is again turned upward, away from the wall, and the fragment crushed. During the crushing the female blade must be held firmly and at an angle of 45° with the horizon, and remain entirely passive (Fig. 1351), and the blades should

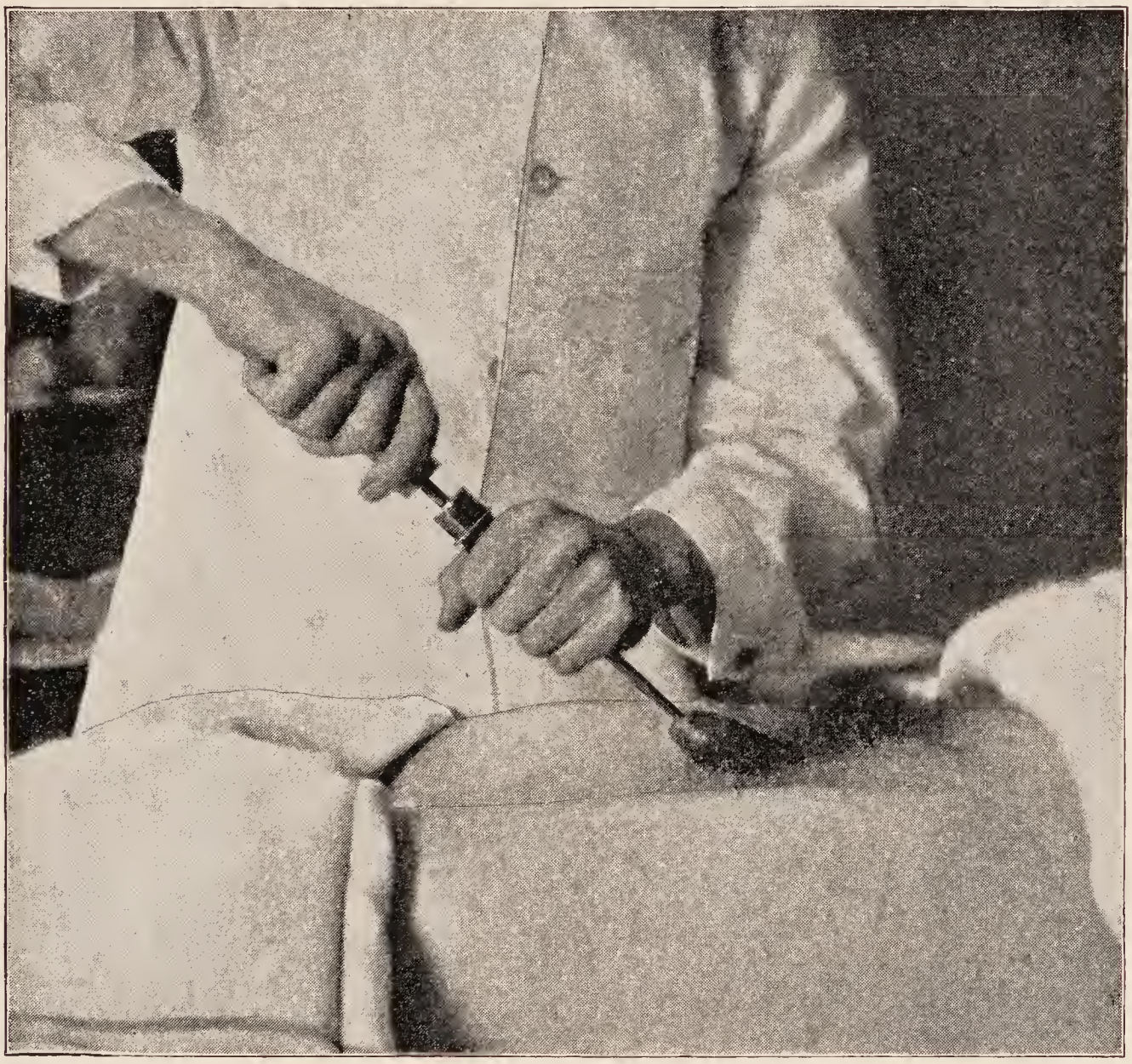


FIG. 1351.—Showing the manner of holding the lithotrite when opening and shutting in the search for fragments.

only be separated sufficiently to admit the stone between them. If the beak be not turned away from the stone before it is opened, the stone may be displaced by the separation of the blades.

*Each sitting*, if without anæsthesia, should not exceed five or ten minutes; with it, a sitting can be prolonged until an ordinary calculus is reduced to fragments, usually from ten to fifteen minutes. When the sitting is completed the blades must be screwed firmly together, so that the instrument may be withdrawn without injury to the urethra. The intervals of the crushing will depend upon the size of the stone, its hardness, and more frequent-

ly upon the effect of the crushing upon the patient. Inasmuch as the conditions differ greatly, it is impossible to lay down any absolute rules. The surgeon should not repeat the operation until the subsidence of the irritation produced by the previous attempts.

*The Precautions.*—The urethra should be sufficiently capacious to permit the wise use of the lithotrite, and the seizing and tearing of the mucous membrane of the bladder should be carefully avoided. If the membrane be caught the movement of the beak toward the center of the bladder will be hindered, and, too, the sensation of seizing a soft instead of a hard tissue may be noticed. However, the grasping of blood clots, pediculated growths, and possibly soft stones when coated with mucus, may simulate mucous membrane seizure. The turning of the beak away from the bladder wall will eliminate these fallacies. If the patient be conscious, the seizure of the mucous membrane will be known quickly by his sensations. Hæmorrhage is rarely sufficiently severe to constitute a complication. Severe bleeding points to the presence of a vascular growth or a grave injury of the bladder or urethra. Not infrequently a congested mucous membrane, though ordinary care in the manipulation of crushing be employed, will cause a perplexing hæmorrhage. The presence of detritus at the borders of the blades, at the time of withdrawal, may damage the mucous membrane of the urethra. However, if they be firmly screwed together, with or without a sharp tap with an instrument, the importance of the fact is reduced to a minimum.

*The Complications.*—The blocking of the lithotrite in the crushing of a pasty stone may happen if the groove for the male blade do not extend to the lower end of the instrument. The author experienced once an embarrassing case of this kind, and knows of a similar one in the practice of a colleague. The non-fenestrated instrument may become blocked so as to prevent the proper closure of the blades and thwart a safe withdrawal from the bladder. Perineal or suprapubic cystotomy, with exposure of the beak and removal of the obstruction, followed by removal of the stone through the opening, is the solution of the dilemma. If the beak of the instrument be broken, cystotomy offers prompt relief. If the bladder be torn through, and the fact be recognized, laparotomy with repair of the tear is indicated, the same as in lithotomy (page 1200). If the deep urethra be ruptured, perineal section is called for. The lodgment in the urethra of a fragment of stone at the time of or immediately subsequent to the operation may cause much trouble, especially if it prevent the flow of urine.

*The After-treatment.*—After the completion of the sitting the patient is given an anodyne, and hot fomentations are applied to the abdomen, and he is caused to remain in the recumbent posture for at least twenty-four hours subsequent to the operation, even to the extent of lying on his side during micturition. If urethral fever or retention occur, or a mild cystitis supervene, the length of the time of confinement in bed and the treatment should conform to the requirements which these conditions impose.

*The Comments.*—Lithotrity is practiced much less than formerly, lithola-paxy being done instead. The pain and perplexity incident to the block-

ing of the urethra by an escaping fragment, especially when large and angular, and the leaving behind of a piece for future development of stone, are sequels to be anticipated in this operation no matter how carefully it may be practiced. The repeated distention of the bladder by water, at the time of crushing, with the idea of causing the discharge of the fragment by the sudden and forcible outrush of the fluid, exposes the patient to the danger of rupture of the organ—a fact which is emphasized by the reported happenings of this accident from the stereotyped plan of the introduction of water during the crushing process. At all events, only operators competent to detect and crush the fragments so as to preclude these accidents should, without some unavoidable reason, practice lithotrity.



Fig. 1352.—Thompson's lithotrite.

*The Results.*—The general rate of mortality is about 11 per cent. The liability of retention in the bladder of one or more fragments exposes the patient to a comparatively prompt return of the trouble.

**Litholapaxy (rapid lithotrity)**, or the crushing and washing out of a stone at a single sitting, has largely supplanted lithotrity.

*The instruments usually employed* in this procedure are the lithotrites of *Thompson* or *Bigelow*, as shown in Figs. 1352 to 1355, the latter being in quite common use. The blades of lithotrites differ in their grinding surfaces from a simple roughening to a well-marked denticulation. The blades of Bigelow's instrument present appearances peculiar to themselves (Figs. 1355 to 1357). The instrument used by *Keyes* is of a stronger pattern than is commonly employed, and is provided with a large wheel at the end that a greater force may be quickly applied. The blades are fenestrated (Figs.

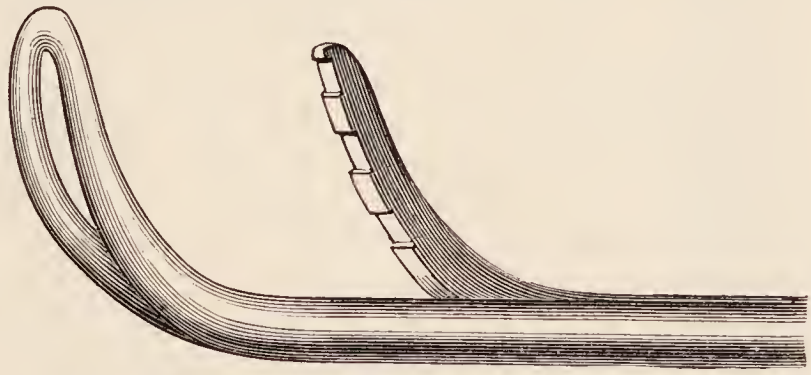


Fig. 1353.—Fenestrated jaws.

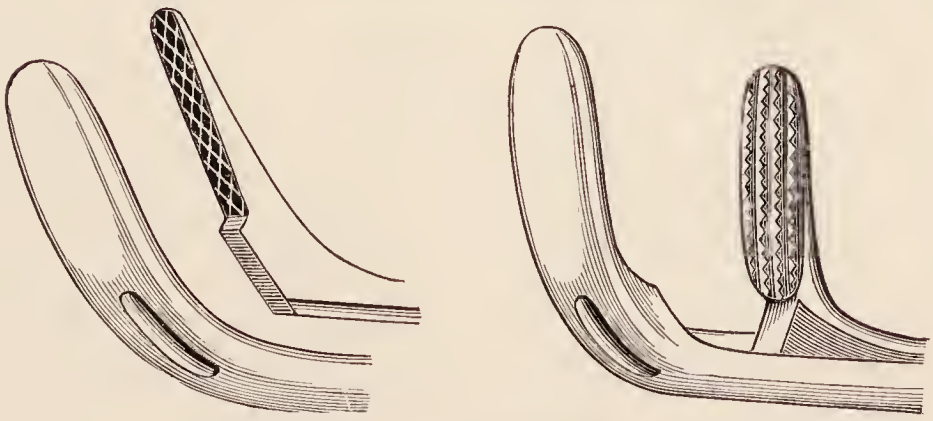


Fig. 1354.—Non-fenestrated jaws.

1358 and 1359), and are so constructed that they will not clog. Forbes has devised a lithotrite of unusual strength, of simple, durable mechanism, and safe and effective crushing power (Fig. 1371, *j*). In all crushing operations

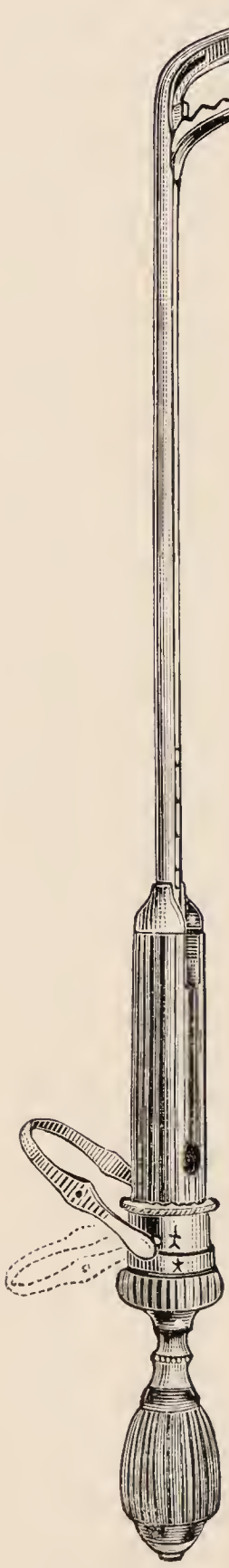


FIG. 1355.—Bigelow's lithotrite.

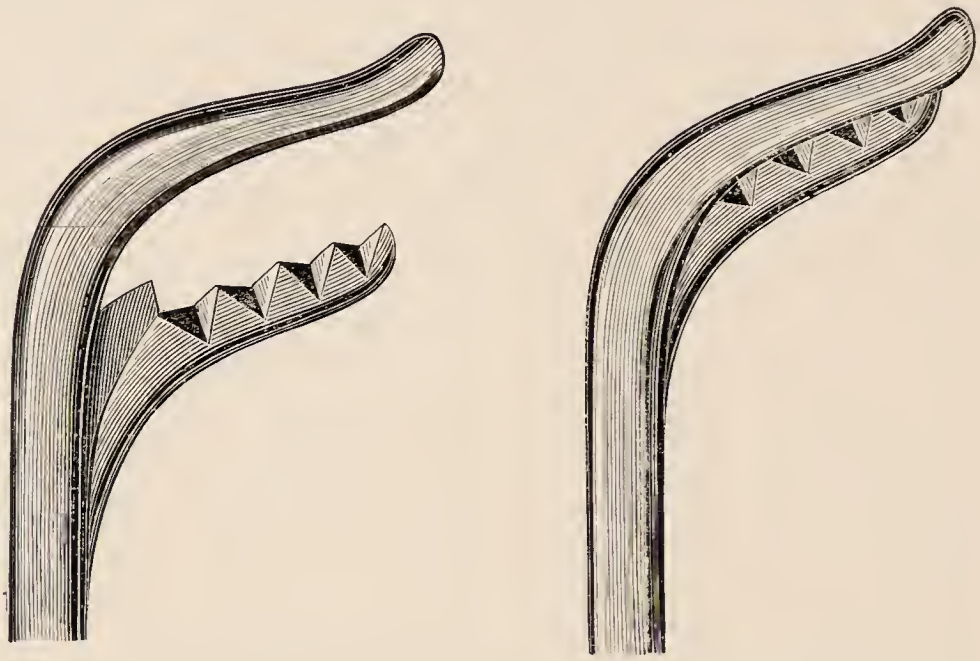


FIG. 1356.—Bigelow's non-fenestrated blades.

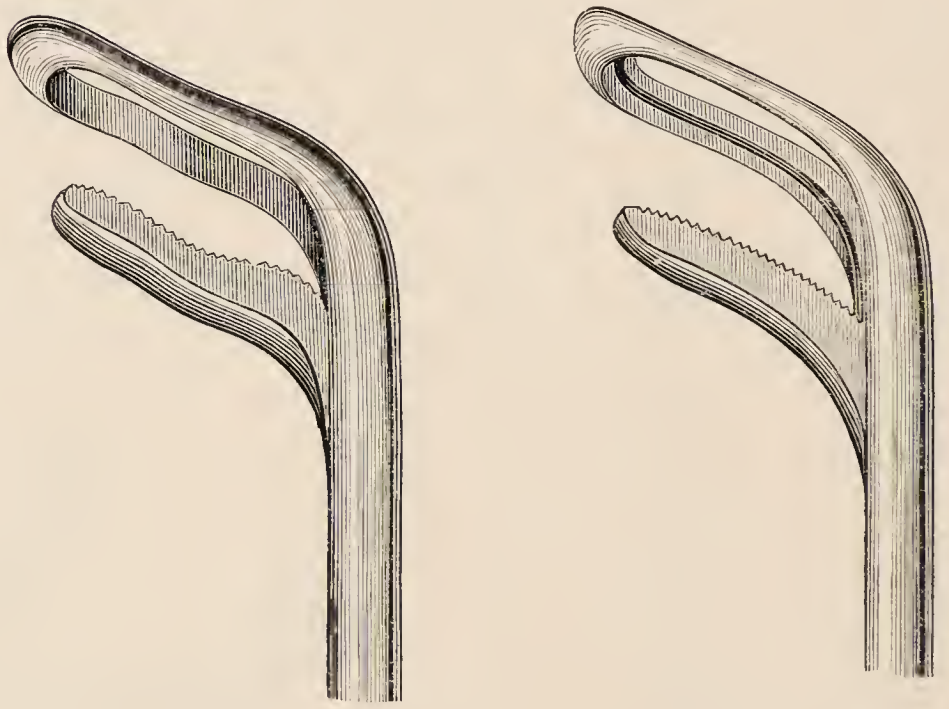
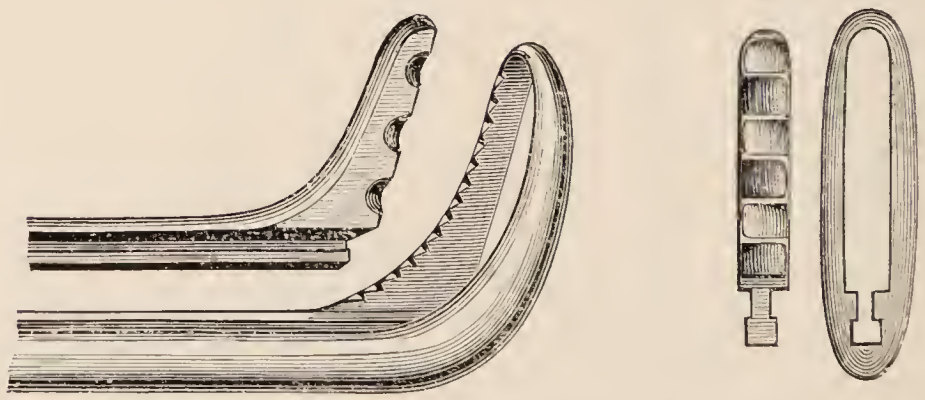


FIG. 1357.—Bigelow's fenestrated blades.



FIGS. 1358, 1359.—Keyes's modified blades.

the operator should possess lithotrites of two or three sizes and of different patterns and power, to enable him to comply with the demands of individual cases, as modified by the hardness and size of the stone, size of the urethra, etc. For crushing large and hard stones a fenestrated blade should be em-

ployed. If the stone be small and friable, the blades may be roughened only, with the male blade much the smaller. A non-fenestrated or "scoop" lithotrite can be used to crush the smaller fragments. The larger and harder

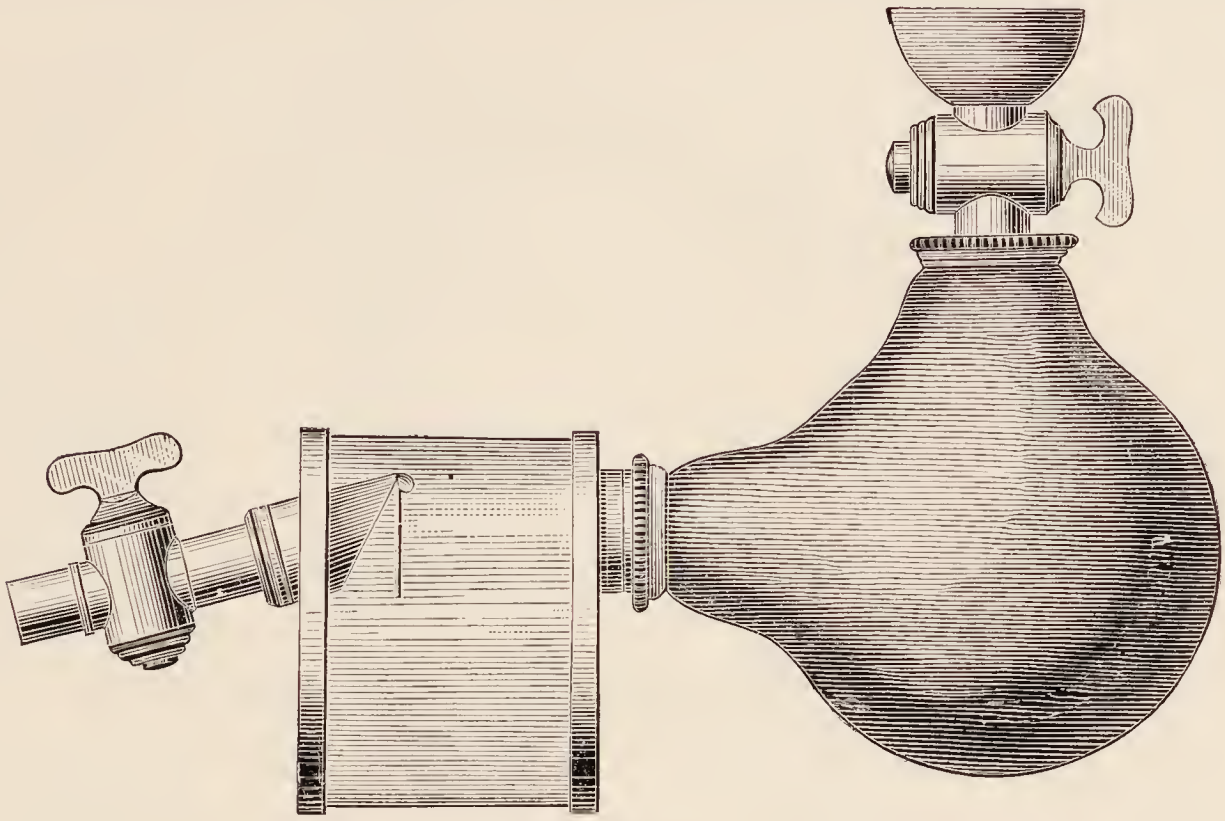


FIG. 1360.—Thompson's evacuator.

the concretion, the stronger should be the instrument employed. In addition to the instruments for crushing, the operator must be provided with an evacuator or washer. The Thompson washer is admirable (Fig. 1360), and

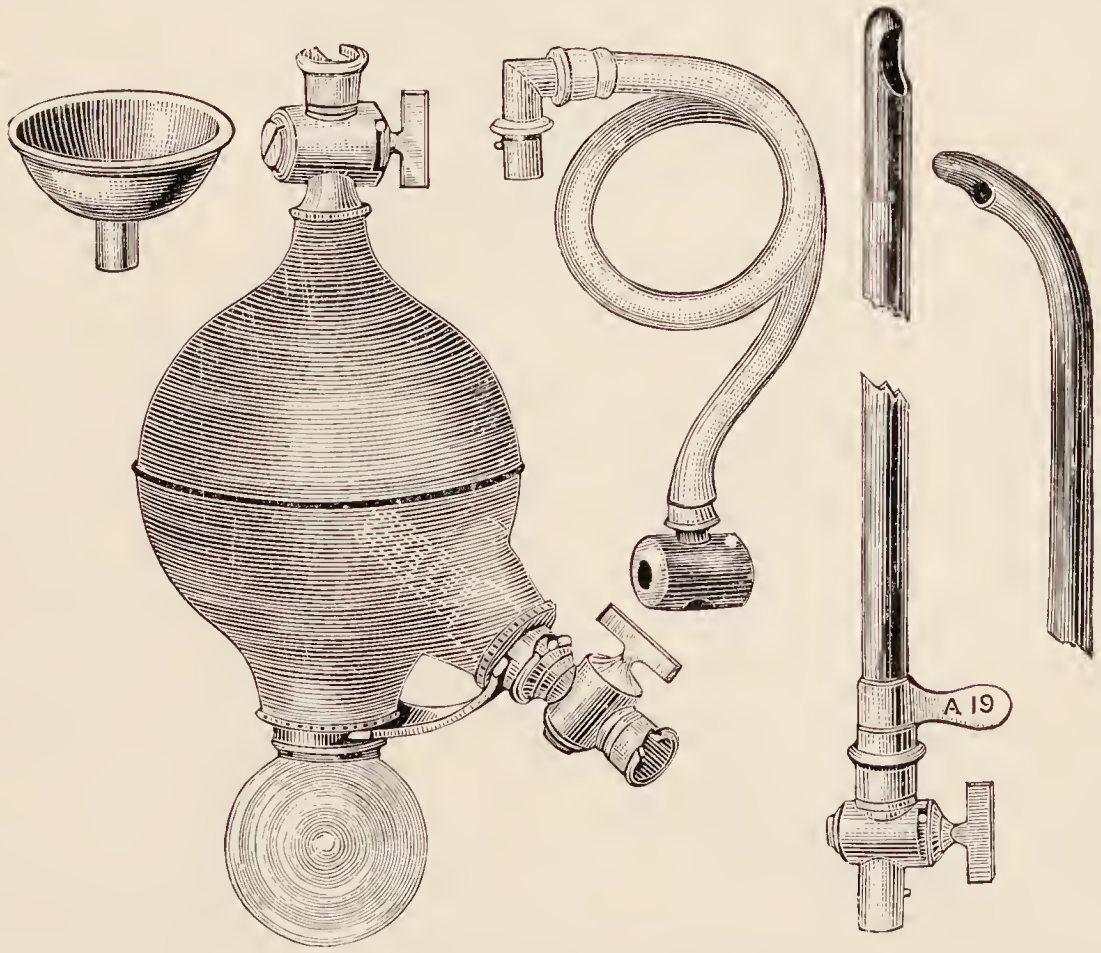



FIG. 1361.—Bigelow's evacuator.

the latest pattern of Bigelow leaves but little to be desired in this respect (Fig. 1361). Otis's washer (Figs. 1362 and 1363) is simple, cheap, and efficient; so also is Chismore's (Fig 1364).

*The evacuating tubes* of Bigelow (Fig. 1365), or their modifications, complete the outfit. The spiral-tipped tube of Warren (Fig. 1366) and the straight, open-ended one of Keyes (Figs. 1367 and 1368) are thought to

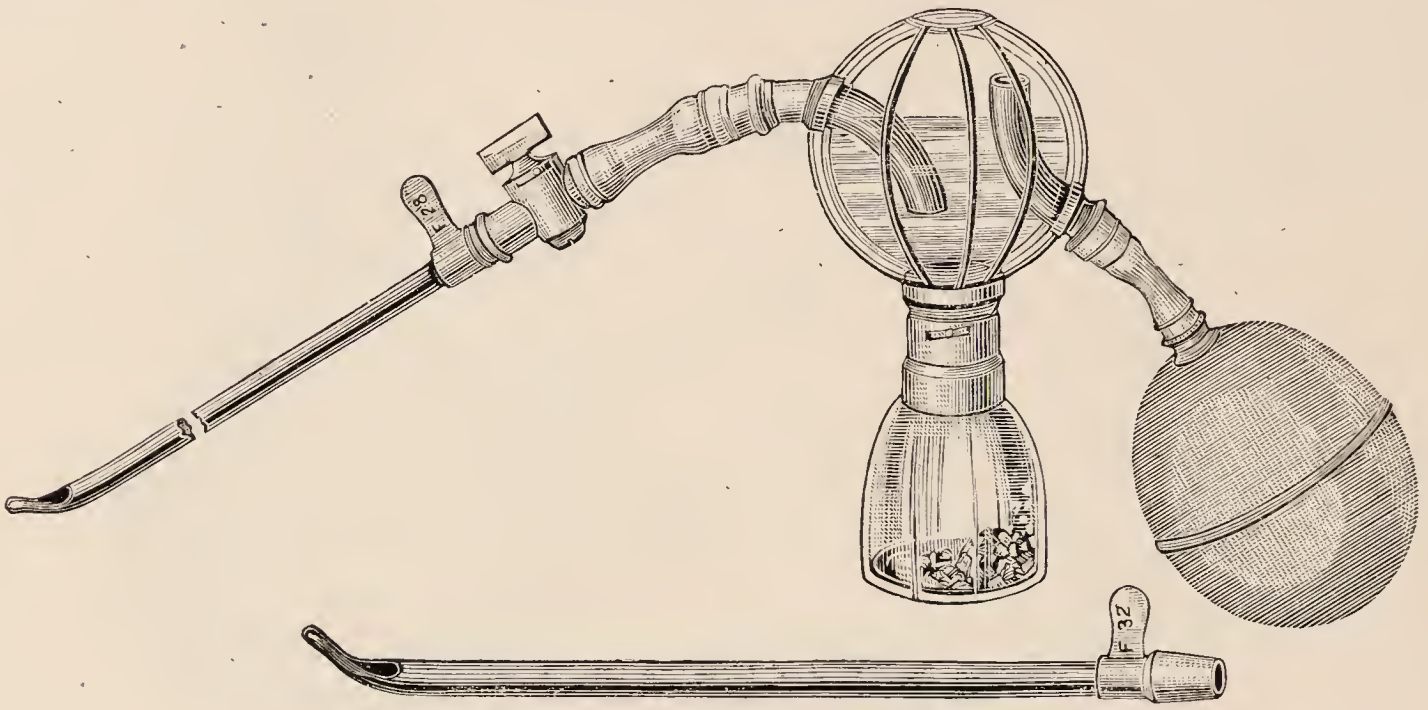



FIG. 1362.—Otis's evacuator, ready for use.

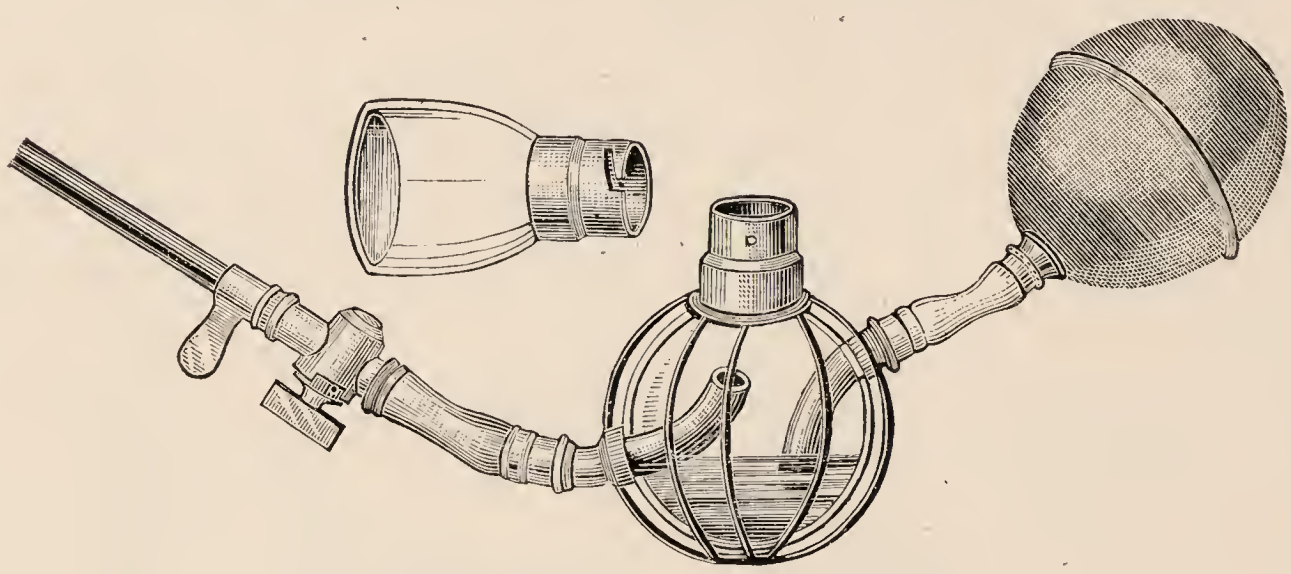


FIG. 1363.—Otis's evacuator, inverted.

facilitate the discharge of the detritus, while, in the latter example especially, the lining membrane of the urethra is not exposed to injury from a fragment lodged in the eye of the instrument during its withdrawal from

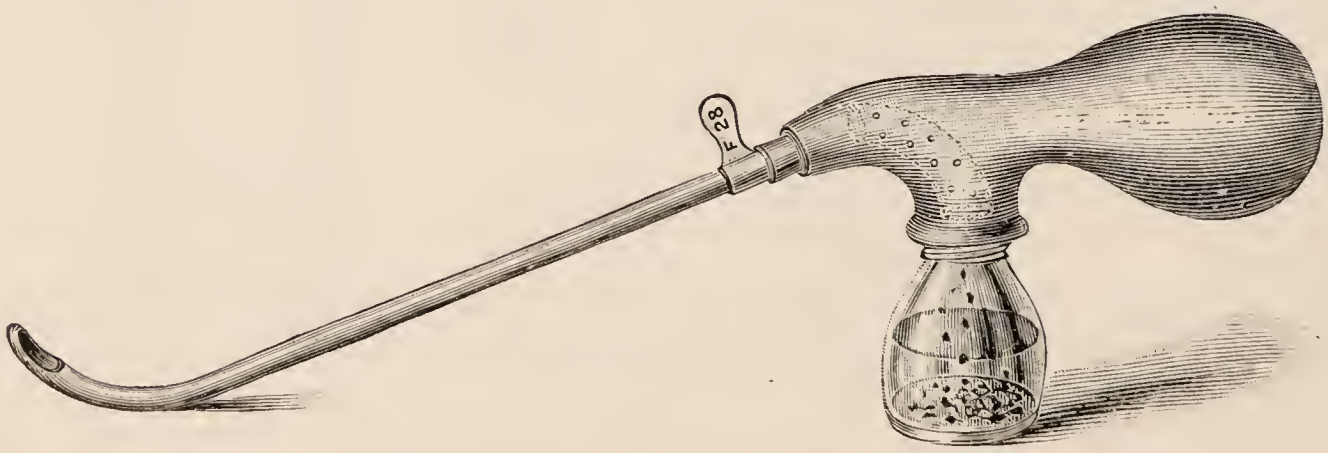



FIG. 1364.—Chismore's evacuator.

the bladder. The size of the tube commonly employed varies from 16 to 18, English scale. Those of different sizes and patterns should be at hand.

*The preparatory treatment* consists in alleviating all bad symptoms dependent upon the existence of the stone, and in preparing the urethra for receiving the instruments by increasing its size if necessary, and subduing any undue sensibility of it. The measures employed preparatory to lithotrity are, of course, of equal importance in this operation.

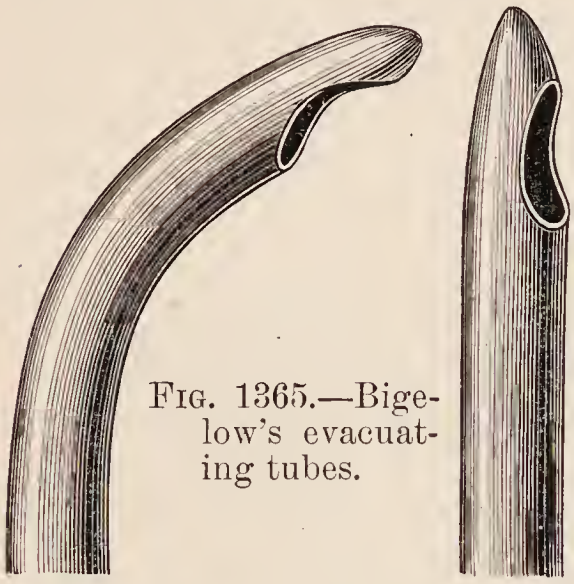


FIG. 1365.—Bigelow's evacuating tubes.

*The Operation.*—An assistant, whose only duty is to empty the washer and adjust it, should be provided. In other matters the technique differs in no essential regard from that of lithotrity up to the time of washing out the bladder.

The method of introduction of the lithotrite and the process of catching and crushing the stone are similar in this operation to the ordinary method, except that the crushing process is interrupted by the introduction of the evacuating catheter as soon as the stone is well broken, which may be within five or ten minutes after the introduction of the lithotrite, depending, of course, upon the success attending the efforts of the operator. A well-lubricated aseptic evacuating catheter is then passed down to the prostatic urethra, but not into the bladder, closely hugging the urethral roof and carefully avoiding the triangular ligament as it passes. The washer is then attached to the catheter at this situation to avoid the entrance of air into the bladder. Before attaching the washer it is filled with a warm boric-acid solution or with sterilized water. The



FIG. 1366.—Warren's spiral-tipped evacuating tube.

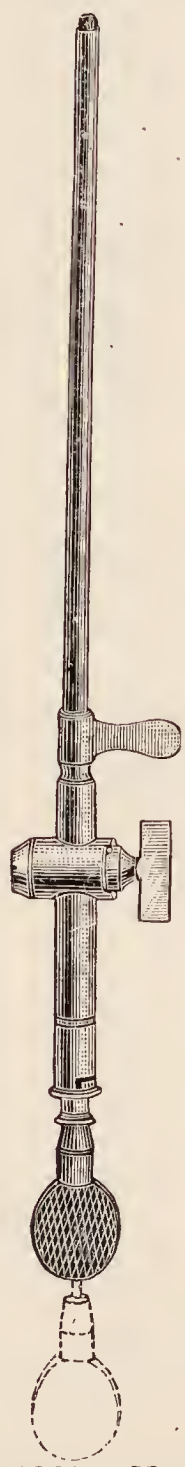


FIG. 1367.—Keyes's straight evacuating tube and guide.

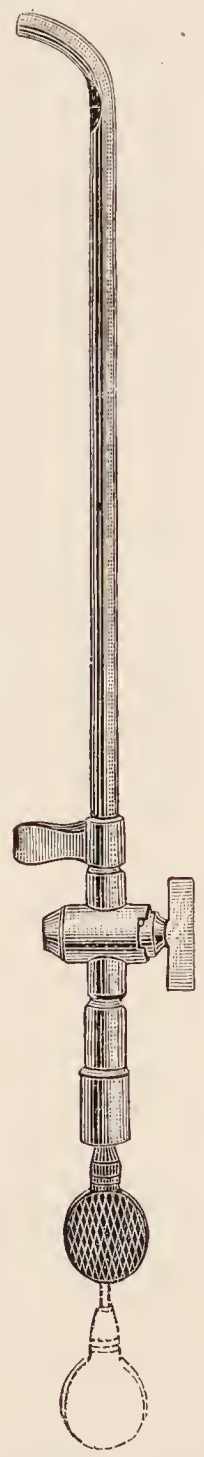


FIG. 1368.—Keyes's curved evacuating tube and guide.

air in the catheter while it is thus located will, if fluid be forced gently into it, pass upward through the fluid in the washer to the air trap above, from which it is excluded before the evacuating tube is carried on into the bladder. If now the elastic bulb be alternately slowly compressed and expanded, the changing current thus produced will wash the fragments from the bladder, and their weight will precipitate them into the glass receiver beneath (Fig. 1369). After expansion of the bulb is complete,

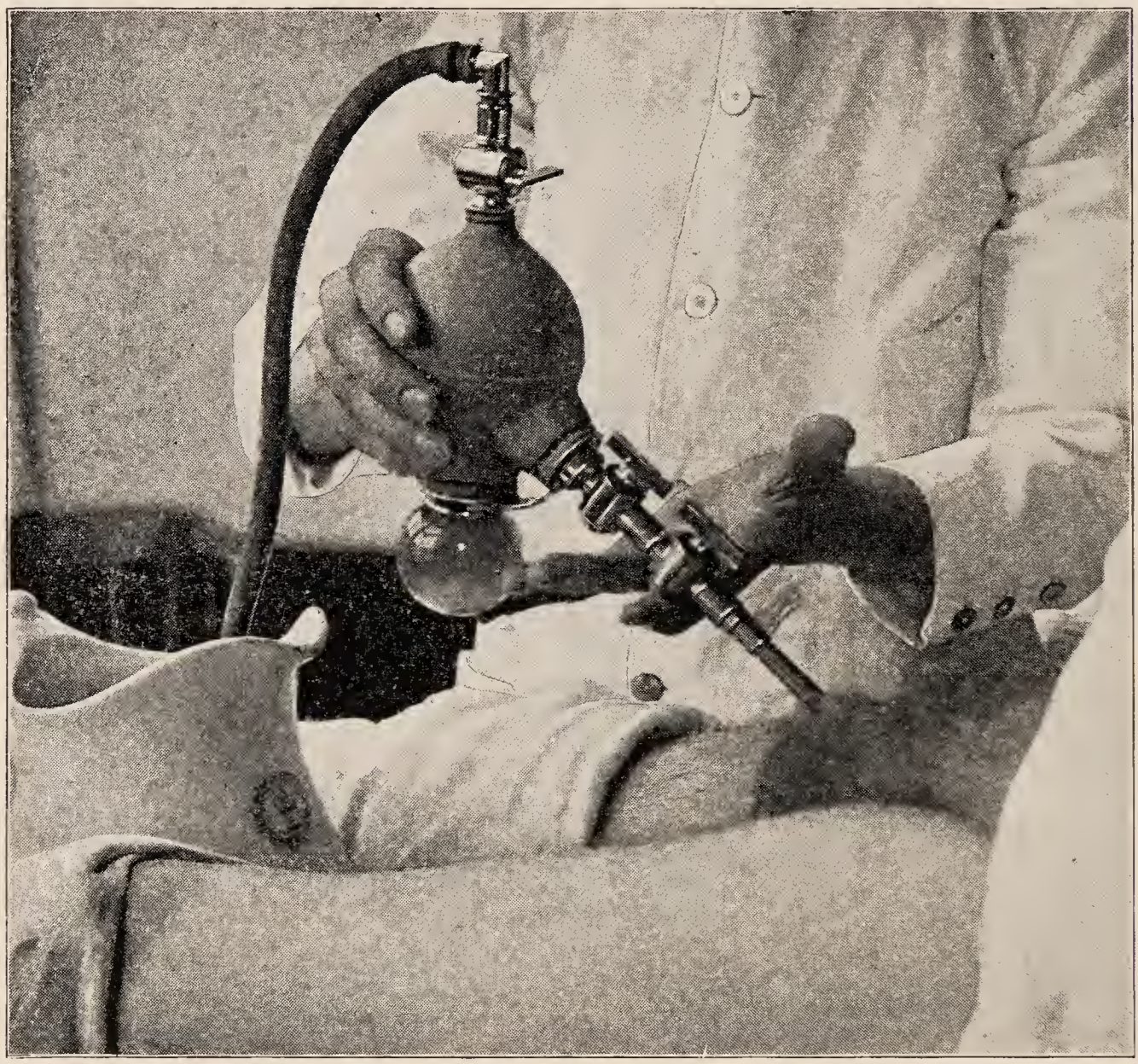


Fig. 1369.—Showing the manner of holding the bulb. The left hand holds the weight while the right manipulates it.

an interval of a few seconds should elapse before pressure is again made, in order to allow all of the fragments in the tube to drop into the receiver. If the outflow cease suddenly, the entrance of the tube is likely blocked with a large fragment, or by the sucking in of the mucous membrane. If all the fragments be not removed—which can be ascertained by the introduction of a searcher, or known by the "click" of a fragment against the evacuating catheter at the time of washing, and by the audiphone—the process of crushing is again resorted to, and the resulting comminutions treated as before until the entire stone is removed. The last fragments not infrequently elude the grasp of the instrument, and, were it not that they can be heard to strike the evacuating catheter when the water flows outward, their existence might not be known. If the curved tube be used the beak should be turned from side to side to present its eye to different as-

pects of the bladder. The square-ended tube of Keyes (Fig. 1367) is passed just beyond the neck of the bladder, and its external extremity is well lowered between the thighs. The author has employed with seeming advantage an evacuating catheter with an additional large eye at the convex surface. With this arrangement it has seemed easier to secure the final small fragments than without it, especially if the bulb were very slowly manipulated. However, it is better sometimes to allow these fragments to remain until the patient has recovered from the operation, and then seek for them again, than to continue indefinitely the attempt to secure the last one at the first sitting. Small fragments that escape detection are not infrequently passed with the urine within four or five days after the operation.

The limit of time to which the first crushing may be prolonged is not an arbitrary one; an hour or two is not unusual, and even a longer time may be employed. However, an hour is a fair estimate of time to occupy in the common class of cases.

*The Comments.*—In profound anæsthesia with deep breathing, the current of the fluid should be the reverse of that of the respiratory current—i. e., running in with expiration, running out with inspiration. The opening of the evacuating catheter should be raised somewhat above the fragments, and suction should not be permitted until they are settled in place. The absence of the "click" during washing is the best proof of the withdrawal of all the fragments. Auscultation of the abdomen or instrument employed in the search will enable one to detect the faintest sound. A thudlike sound, attended with brief arrest of the flow, is suggestive of the indrawing at the eye of the catheter of the mucous membrane of the bladder.

*The Precautions.*—The entrance of air to the bladder during the washing out should be avoided, since its presence there causes a churning sound which obscures the click of small fragments and hinders a proper flushing of the viscus. The air can be removed by slow manipulation of the bulb with the end of the tube at the uppermost portion of the bladder. The presence during withdrawal of the catheter of a stone in the eye of the instrument may lacerate the urethra; therefore, a suspicion of such a fact calls for a clearing out of the instrument before its withdrawal. The fickleness of rubber goods emphasizes the wisdom of having two evacuators at places far removed from the base of surgical supplies, as the writer once had occasion to know. The passage of an evacuating catheter with a large eye along the urethra must be done cautiously, or the mucous membrane will be cut by the border of the eye. In fact, it is better to close the opening in advance with an obturator, which can be easily removed after the introduction, than to incur the danger of injury by omitting closure. The complications of crushing are stated under Lithotrity (page 1164).

*The After-treatment.*—After the operation the patient is kept quiet in bed and well wrapped; if retention occurs, it is relieved by a catheter. *Vide* Lithotrity.

*The Sequels.*—Litholapaxy has various sequels—rigors, retention of urine, cystitis, epididymitis, atony of the bladder, suppression of urine, etc.—each of which should be anticipated, and treated on general principles.

*The Results.*—Under ordinary circumstances the patient will be up and around at the end of a week or ten days. The rate of mortality is from 1½ to 7 per cent, depending on the character of the case and the skill of the operator. Rarely a return of the stone is experienced except as the result of the initial cause. The results are better in women than in men.

**Litholapaxy in Children.**—Until quite recently it has been regarded as inexpedient and even positively dangerous by some to employ litholapaxy in children. But, inasmuch as nearly half the cases of calculi occur in children, and the outcome of the operation was so favorable in adults, the objectionable barrier of youth was quite promptly broken down by the favorable results of the operation when carefully practiced at the tender age by experienced hands. It was soon found that the diameter of the urethra in the youth could be as safely and suitably increased in size as in the adult. Also that the urethra and bladder of the young are very tolerant of instrumentation. While it is true that the mucous membranes of the young are more delicate than those of the old, still, the employment of extra caution, and the absence of concomitant complications of stone in children, together with their stronger inherent tendency to recovery, made the final outcome in them quite as good as in the most favorable adult cases. In children, instruments of a smaller caliber are required and a due recognition of the higher position of the bladder is needed to safely secure the desired consummation in both crushing and cutting. But these anatomical peculiarities of youth make lithotomy all the more difficult. Added to this is the danger of irreparable injury of the seminal ducts in perineal lithotomy. The preparation of the patient and the general and special technique of the procedure is similar to that in adults. The complications are less frequent, though their avoidance and remedy is equally important.

*The Results.*—In 1,213 cases performed by eleven operators the average mortality was 2.22 per cent (White and Martin).

**Combined Crushing and Evacuation.**—The idea of the possible utility of such a combination occurred to us in 1884, after a somewhat annoying effort on our part to seize the "last fragment," the existence of which could be easily and quickly demonstrated by the characteristic click against the eye of the evacuating catheter during the washing-out process. We also recalled the fact that on other occasions the suction force of the washer had been temporarily arrested by the closure of the eye of the evacuating catheter by a fragment of calculus. In the construction the male blade of an ordinary lithotrite was modified to fit the anterior wall of the ordinary evacuating catheter, which is lined with a brass tube. The washer was easily connected with the instrument, as shown by the cut (Fig. 1370). It was not expected that this instrument would supplant the lithotrite. The idea was to crush the stone at the first introduction of the lithotrite as effectually as practicable, and then to introduce the combined instrument instead of the ordinary evacuating catheter. By means of this the detritus could be removed from the bladder, and such of the remaining fragments as were caught in the throat of the instrument could be crushed and likewise

removed. It thus was possible to avoid the interchange of instruments incident to repeated crushings. With an assistant to manipulate the washer, the operator can devote his entire attention to crushing the fragments caught in the throat of the instrument.

*Chismore* has done much, indeed, by practice, precept, and ingenuity, to establish on a still stronger basis the operation of litholapaxy. He divides the cases practically into two classes: 1, those in which the prostate gland is normal in size; 2, those in which it is enlarged, and remarks: "In the former the operator may confidently rely on clearing the bladder at one sitting; in the latter several crushings may be required, and the patient should be distinctly informed of that fact before the operation, in order that he may not, in his disappointment at not being entirely relieved at once, refuse to submit to further attempts."

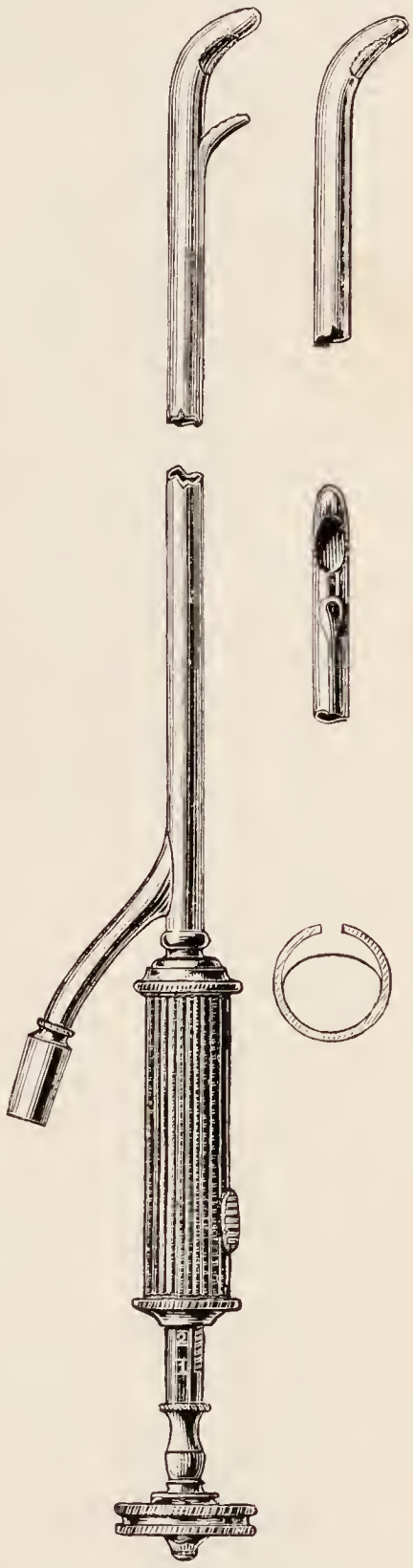


FIG. 1370.—The author's combined instrument.

Regarding the use of his outfit and the method of practice he writes (September 12, 1900) us as follows:

"My essential instruments for litholapaxy are three: A combined crushing and evacuating lithotrite (Fig. 1371, *d*, with enlarged blades); an aspirator, very simple in construction (Figs. 1364 and 1371, *i*), without stopcocks and of such a shape as to fit the hand, and when coupled to the lithotrite it forms an excellent handle not interfering in the least with delicacy of touch; and an automatic hammer (Fig. 1371, *g*) that when vigorously applied to the lithotrite will crush the hardest stone. I have also modified Sir Henry Thompson's searcher, making the shaft to correspond in length, curve, and graduation marks with those of the lithotrite, shaping the external end of the handle so as to fit my aspirator, and providing it with a movable index.

"For the idea of an evacuating lithotrite I am indebted to you. Several of the older lithotrites had catheters in one or the other of the blades, but they were used solely for the purpose of increasing or diminishing the amount of fluid in the bladder during search or operation.

"The catheter in my instrument is in the male blade, the external end of which is made to fit my aspirator, so that I can avail myself of the to-and-fro current during aspiration to draw a stone or its fragments into the jaws—the first lithotrite, I believe, to make use of this principle.

"The lithotrite is carefully prepared, by taking it apart, coating the shaft of the male blade with lanolin ointment containing ten grammes boric acid to the ounce, and putting the instrument together, working it back and

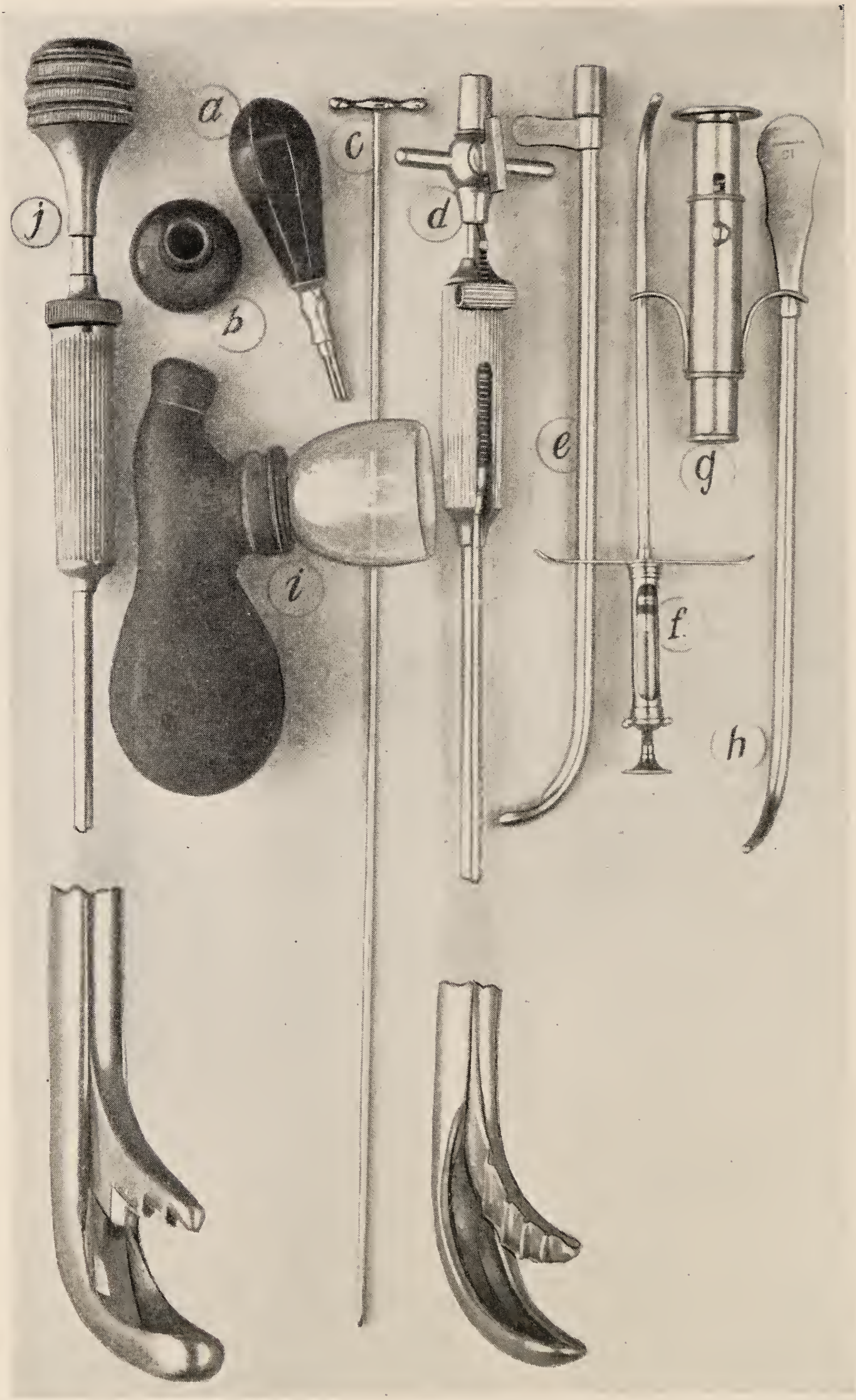



Fig. 1371.—Instruments employed by Chismore in litholapaxy. Also Forbes's lithotrite.

*a*. Pinion to lithotrite. *b*. Cap for hand pressure. *c*. Detritus dislodger. *d*. Chismore's lithotrite with magnified blades. *e*. Evacuating tube. *f*. Keyes's syringe. *g*. Automatic hammer. *h*. Curved steel sound. *i*. Chismore's washer, also Fig. 1364. *j*. Forbes's lithotrite with magnified blades.

forth until the ointment is evenly distributed between the tubes, making a packing impervious to air or water.

"A patient with normal prostate is placed on the operating table on his back, buttocks well down to the end, thighs moderately flexed, and the feet supported. A half drachm of a four-per-cent solution of cocain is thrown into the deep urethra by means of a Keyes syringe (Fig. 1371, *j*), a No. 13 Van Buren (*h*) sound is gently passed, and the size and condition of the urethra noted. If a preliminary meatotomy is necessary it is done under cocain.

"Gently introduce the searcher (Fig. 1343) and empty the bladder, even if the patient has just voided his urine. If this is not done there may be several ounces remaining and the operator be greatly misled thereby. The aspirator is filled with a warm solution of boric acid, coupled to the searcher, and about three fluid ounces injected. Careful, methodical search is then made over every part of the bladder that can be reached. In such cases the stone is usually found in the region of the base of the bladder to one side of the median line—most frequently to the right. A negative result should not always be taken as conclusive, especially if the patient is nervous and apprehensive. Manipulation under such circumstances should not be too prolonged. It is better to defer giving an opinion until a subsequent visit, when a better judgment can be formed. Several times it has happened to me to easily find a stone, and not always a small one at that, which has eluded search on the first trial. If a stone is found, note carefully its location—feel for its farthest border—and, having found it, set the index on the searcher at the meatus. Then strive to approximate its size by withdrawing the searcher until its nearest border is felt. Note the angle which the shaft of the searcher makes with the axis of the body. The bladder is once more emptied through the searcher, and from an ounce and a half to three ounces of warm four-per-cent solution of cocain is injected through it by means of a rubber tip penis syringe. It is much more convenient to work in a small bladder than a large one; more than three fluid ounces are seldom required—less than that quantity is often better. While this is taking effect, the lithotrite and its appurtenances are placed within convenient reach, a large pan of warm solution of boric acid prepared, the aspirators (two) filled, and the tubes laid out.

"An assistant is needed to apply the pinion (Fig. 1371, *a*), when required, and to empty, refill, and hand the aspirators. But I have often done the operation alone. By this time—about five minutes after the injection of the cocain—the bladder is anæsthetized. The lithotrite is then properly warmed, anointed, and gently introduced. Too much care can not be taken in this step of the operation. Holding it lightly, gradually slip it along the urethra until the anterior triangular ligament is reached (Figs. 1378 and 1379). If there is obstruction wait patiently. Gently search along the face of the ligament for the urethral opening. Let it go its own way, do not try to force it, and presently spasm will relax, and it will slip in without pain or injury to the delicate and resentful structures. Once in the bladder, I carry the end of the closed lithotrite a little beyond the farthest border of the stone. Observe

that the shaft is at the same angle with the axis of the body, as noted by the searcher. Open the instrument to the size of the stone, or a little more, reverse the beak to the locality of the stone, and, on closing the jaws, it is caught usually at the first trial. If failure attends, I seek again and again until success is attained. Should I not be able to readily grasp it in this manner, I open the jaws to the fullest extent that the bladder will permit without force, gently push the bladder upward with the female blade, at the same time depressing the jaws by elevating the handle of the lithotrite, thus imparting to the viscus a V shape, with the open jaws of the instrument in the angle of the trough. Then, coupling on the aspirator (filled), compress the bulb and throw an ounce or more of its contents in. This creates a current which raises the stone up, when, smartly relaxing the bulb, the returning flow sucks the stone into the jaws. Sometimes these manœuvres have to be repeated many times before the stone is caught, varying the angle of the shaft, and lateralizing, or even reversing, the jaws. Each time fluid is withdrawn. Before again compressing the bulb it is used as a handle to the lithotrite. The jaws are gently closed to learn if the stone be within its grasp.

"Having secured the stone, and before grasping it tightly, move it in all directions to be sure you have not included any living tissues, and also to ascertain if there be more than one. If free, carry it to the center of the bladder and try to crush it by means of the hand cap (Fig. 1371, *b*). If too firm for that, the assistant inserts the pinion (*a*) and gradually puts on the force until the stone yields or again proves too strong. In this case the assistant holds it as firmly as possible with the pinion while the operator removes the hand cap and fixes the automatic hammer (*g*). With the hammer in the hollow of the right hand he makes firm pressure in a line with the shaft of the lithotrite. This pushes the piston a little inward and 'sets it.' Then with the first and second fingers of the same hand he brings the lugs smartly home, which releases the hammer and delivers the stroke. He repeats the manœuvres as often as needed, and it will be a tough stone, indeed, that does not yield to the shattering blows. During this procedure the left hand grasps the fluted handle of the female blade of the lithotrite, controls the position of the jaws within the bladder, and also furnishes the needed counter-resistance to the force of the hand cap (*b*), pinion (*a*), or hammer (*g*). Practically the hammer will seldom be needed.

"Having broken the stone, the fragments are much easier dealt with, since they gravitate to the locality originally occupied by the stone, where they can be readily found.

"If the stone is small, the aspirator will remove the fragments through the lithotrite as fast as it is crushed. If it is a large one, it is better to remove the lithotrite from time to time and introduce as large a tube as will pass without undue tension, and, with the aspirator, wash the *débris* out through it. If the detritus be impacted in the blades or lumen of the instrument the disengager (*c*) is introduced and the obstacle is dislodged.

"During this time the patient should have suffered but moderate pain. If pain becomes troublesome, open the stopcock in the lithotrite, let out the

contents of the bladder, and, without hesitation, inject one and a half to three ounces of fresh cocain solution. I have frequently kept in the bladder a four-per-cent solution for more than an hour, and, on occasions, over three hours, without toxic effect. When the whole of the stone is removed a few bulbs of borated solution are thrown in and allowed to escape, for the purpose of removing the cocain, taking care not to distend the bladder. The patient may then dress and go home, with directions to remain in bed until the soreness and irritation have passed away, to save all urine passed for inspection, and to send for medical aid in case of chill or pain.

"*Special Precautions.*—If the beak of the lithotrite is reversed, the operator should always bear in mind the fact that the line of the reflection of the recto-vesical fold of the peritonæum (Figs. 1378 and 1405) fixes, in a measure, that portion of the bladder to which it is attached. Below and above this transverse line the jaws of the instrument will easily push the walls of the viscus before them, when, if closed, a fold of the bladder is almost surely included in the bite. A knowledge of this fact, together with the easily recognized 'feel,' will serve to prevent injury from this source. If both jaws happen to be below the vesico-rectal fold, on attempting to open the instrument a false sense of sacculation is the result.

"*The After-treatment.*—Little need be said of after-treatment. When the whole of the stone is removed there is rarely any trouble. Should any fragments be left too large to pass the urethra they will give notice of their presence by pain and frequency of micturition, and the urine will continue cloudy with pus and mucus. I have found the sensations of patients very reliable as to a remaining piece. When they declare that they 'feel a piece' there is nearly always one present, and it should be sought for as soon as irritation from previous operation has subsided. An attack of urethral fever may come on at the first voiding of urine, especially if the deep urethra has been stretched much during the operation, but it subsides for the most part during the first twenty-four hours. A little morphin and quinine is all that is required.

"Small fragments become slippery with a coating of pus and mucus, and are voided with but little suffering. Often the action of the aspirator is so thorough that not a single grain of calculus is left. When a small fragment is suspected it is well to let the patient, when the bladder is full, stand upright while a full-sized litholapaxy catheter is gently passed. A small piece or pieces may often be got rid of by this simple method. Such cases are usually up and about in two or three days. I have never had a case of chronic cystitis follow the complete removal of a stone when the prostate was normal, nor have I yet had a fatal result, or any severe complication, follow a crushing operation in this class of cases.

"*In cases where the prostate gland is enlarged* and catheter life is begun, the proceeding is the same, save that the patient is plainly told that several sittings may be required to free his bladder from stone. Where the mass of the hypertrophied prostate encroaches upon the bladder, it removes a considerable area from the direct command of the lithotrite, and pieces may lodge there in such a way that prolonged manipulation will not secure them. In

view of the fact that the urethra must be regularly traversed by the catheter at short intervals after the operation, I seize, crush, and remove as much as I can without creating too much disturbance, and defer the removal of the rest until the irritation caused by instrumentation has subsided. It is in these cases that the current through the lithotrite comes into play to best advantage, making the pieces hunt the instrument instead of the instrument hunting the pieces.

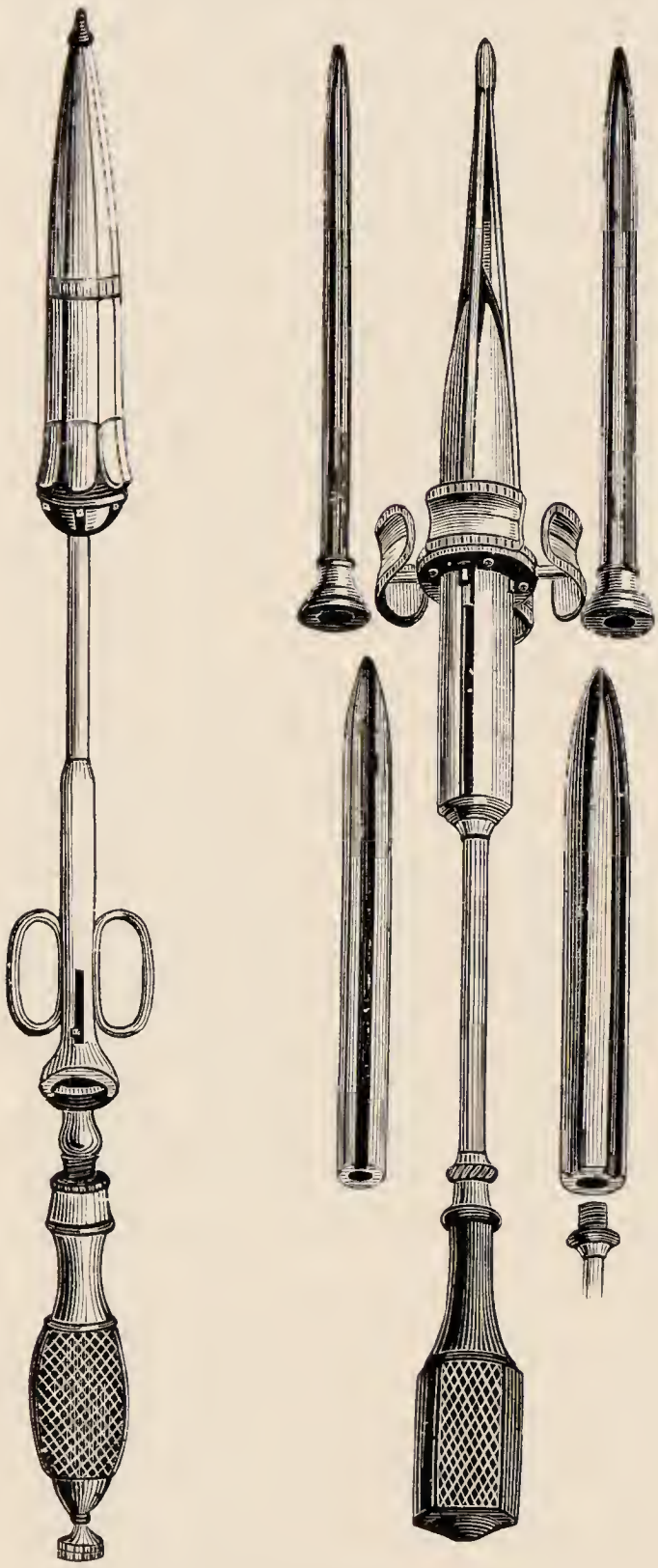


FIG. 1372.—Dolbeau's dilator.

*The Results.*—"I do the greater number of the operations on my office table—often at a first visit. I have been using my lithotrite sixteen years; have operated on one hundred and twenty-one cases. There have been three deaths within a month of the time of operation. An autopsy in each leaves no doubt that the practice had nothing to do with the fatal results in two cases, and that the third might possibly have been saved by lithotomy. Many of the cases were in a most pitiable condition—old, worn with pain, marked degeneration of important organs, kidneys, liver, and heart."

**Perineal Lithotrity with Litholapaxy.** — A stone may be crushed through an opening in the perinæum. Perineal lithotrity has as yet been rarely adopted as a primary method of treatment, but rather as an expedient to facilitate the removal of a stone too large to be extracted through the incision made for the purpose of a simple lithotomy. It has been advocated (perineal litholapaxy) as a substitute for lithotomy in large stones, because the crushing and the use of the washing apparatus can be substituted for the necessary incision through the deeper parts. Still, the withdrawal of an ordinary-sized stone can hardly compare in point of danger to the repeated introduction of instruments and the necessary prolongation of the operation of crushing through an open wound, especially in the hands of the inexperienced. However, it is, without doubt, an expedient which should be more frequently adopted, particularly for the removal of large stones through an opening too small to admit of their safe withdrawal.

*Dolbeau* systematized perineal lithotrity and crushing for the treatment of large stones.

*The Operation.*—Make an incision through the perinæum as in median lithotomy (page 1192), after which the dilatation is divided into three steps, the dilator of Dolbeau being employed (Fig. 1372). *The first step* consists in the dilatation of the tissues down to the groove in the staff (Fig. 1373); *the second*, the dilatation of the tissues nearly through the neck of the bladder (Fig. 1374); *the third*, the withdrawal of the staff and the carrying of the dilator sufficiently to thoroughly dilate the neck of the bladder when expanded (Fig. 1375).

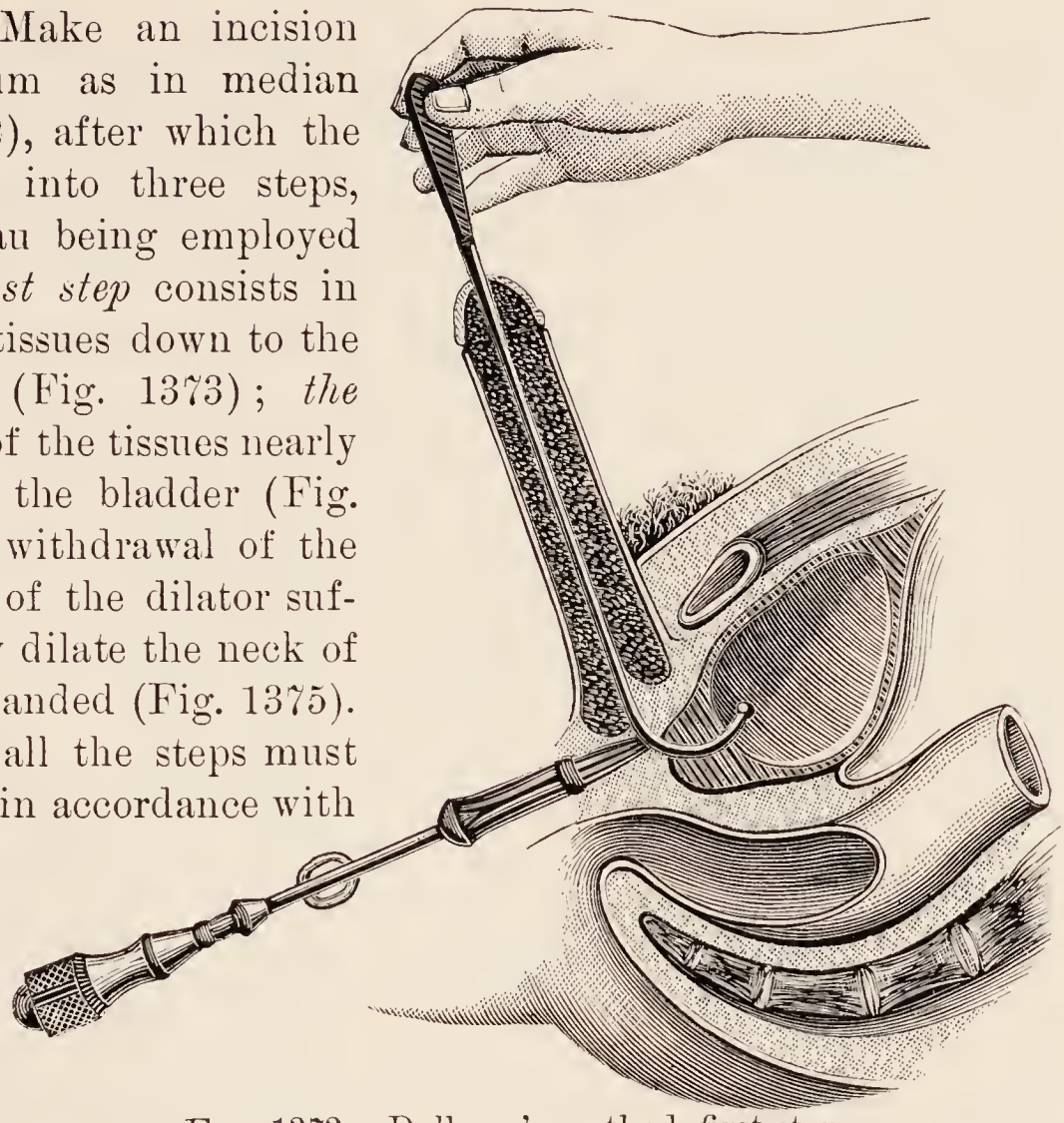


Fig. 1373.—Dolbeau's method, first step.

The dilatation in all the steps must be done carefully and in accordance with the resistance encountered. The prostate and the neck of the bladder can be dilated one inch without danger. After it is completed a lithoclast (Fig. 1376) of suitable size is introduced and the stone fragmented, after which it comes away with the urine. A small reverse current (Fig. 1388) of warm aseptic and carbolized water thrown into the bladder can be used to wash the fragments out. Dolbeau's shield (Fig. 1377) for protection of the soft parts during crushing should be employed, especially in severe and protracted cases.

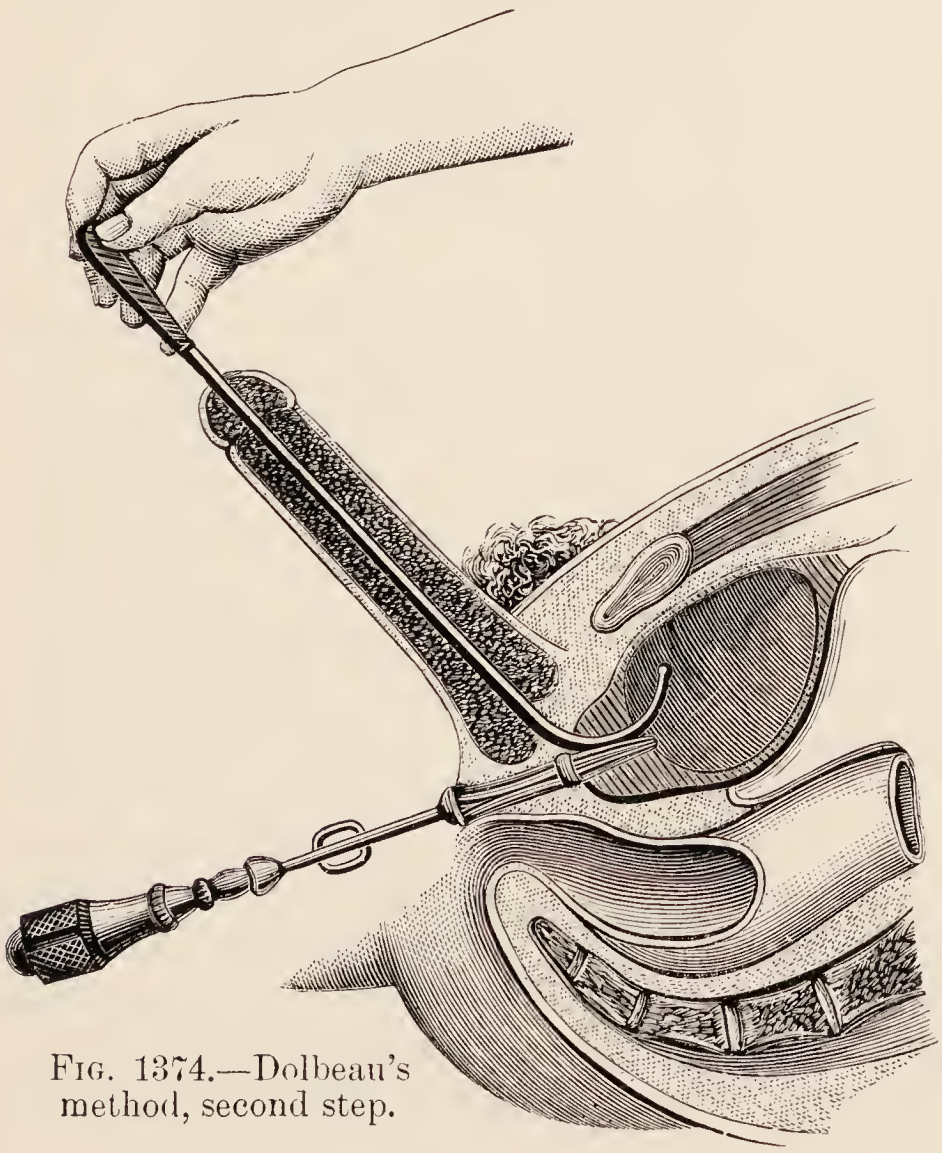


Fig. 1374.—Dolbeau's method, second step.

*Reginald Harrison*, after much experience, expresses the belief that the introduction through the prostate of a small tapering gorget (Fig. 1314, *d*) (Teale's, Fig. 1314), followed by dilatation with the index finger, is a safer and more satisfactory method of entrance to the bladder in this operation than the

use of the Dolbeau dilator, as the latter is liable to inflict serious injury. Also he advises the use of crushing forceps with blades resembling those of a lithotrite, with a cutting rib between them, and the handles provided with a screw for strong leverage purposes. The fragments are removed by evacuating catheters of the size of the perineal wound—about the size of the index finger—and directly by the use of forceps.

Harrison regards the operation favorably for the following reasons: "1. It enables the operator to crush and evacuate large stones in a short space of time. 2. It is attended with very little risk to life as compared with other operations where cutting is done, such as lateral or suprapubic lithotomy, and is well adapted to old and feeble subjects. 3. It permits the operator to wash out the bladder and any pouches connected with it more effectually than by the urethra, as the route is shorter and the evacuating catheters are of much larger caliber. 4. The surgeon can usually ascertain, either by exploration with the fingers or by introduction of the forceps into the bladder, that the viscus is cleansed of all *débris*. 5. It enables the surgeon to deal with certain forms of prostatic outgrowth and obstruction, complicated with atony of the bladder, in such a way as to secure not only the removal of the stone, but the restoration of the function of micturition. 6. By the subsequent introduction and temporary retention of a soft-rubber drainage tube, states of cystitis due to retention of urine in pouches and depressions in the bladder wall are either entirely cured or are permanently improved. To lock up unhealthy ammoniacal urine in a bladder that can not properly empty itself, after a lithotrity, is to court the formation or recurrence of phosphatic stone. Hence it is well suited to some cases of recurrent calculus."

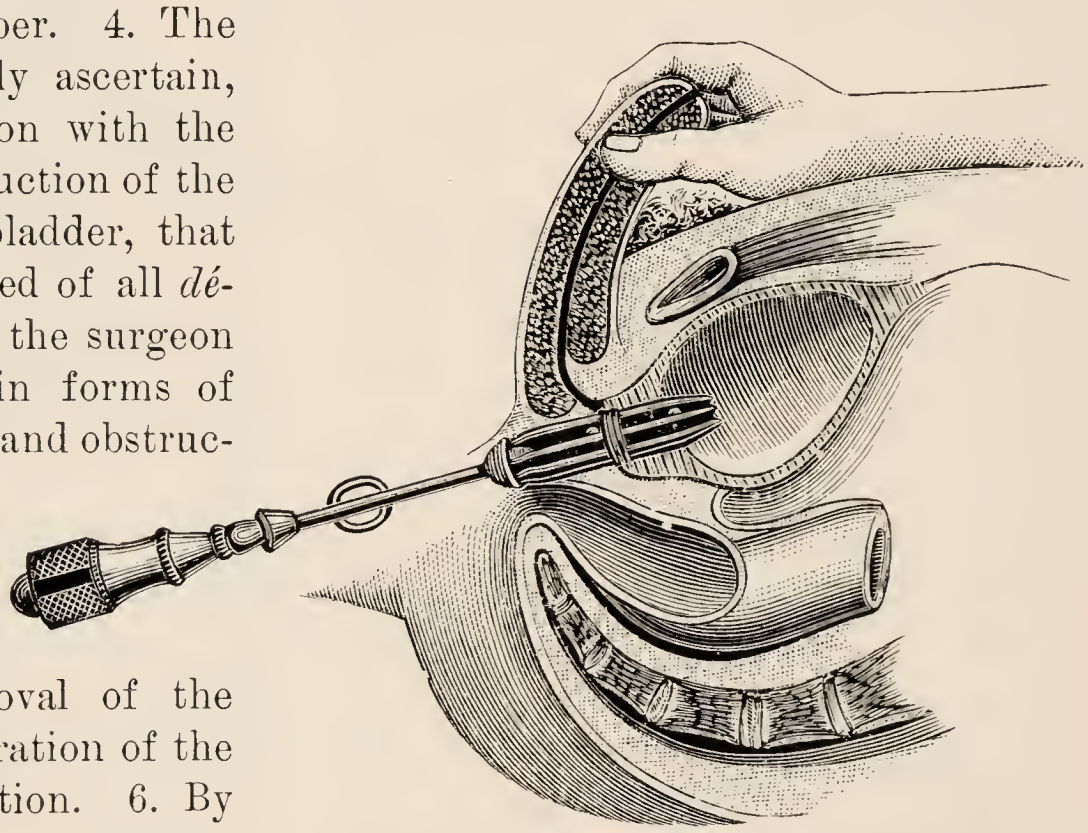


FIG. 1375.—Dolbeau's method, third step.

He regards it well adapted to cases of stone complicated with deep stricture, as then both can be treated at the same time. It lessens the risk of the performance of lithotrity in the presence of a permanently damaged urethra.

*The Results.*—The results are eminently satisfactory, much better than are secured by other methods in similar cases. Harrison reported 14 cases in 1894; all successful.

**Lithotrity in the Female.**—The absence of the prostate body and the shorter and larger urethra of the female combine to secure a more complete emptying of the bladder, and also lessen the liability to the formation of vesi-

cal calculi. A stone in the female bladder can not be grasped with the same facility as can one in the male, owing to the difference in the normal shape and surroundings of the bladder and to the pathological modifications to which its cavity is subjected, due to its connections with the uterus and vagina, and the physiological and pathological variations caused by child-bearing and its sequels. The greater liability to a sacculated base requires that the instrument be reversed more frequently than in the sterner sex.

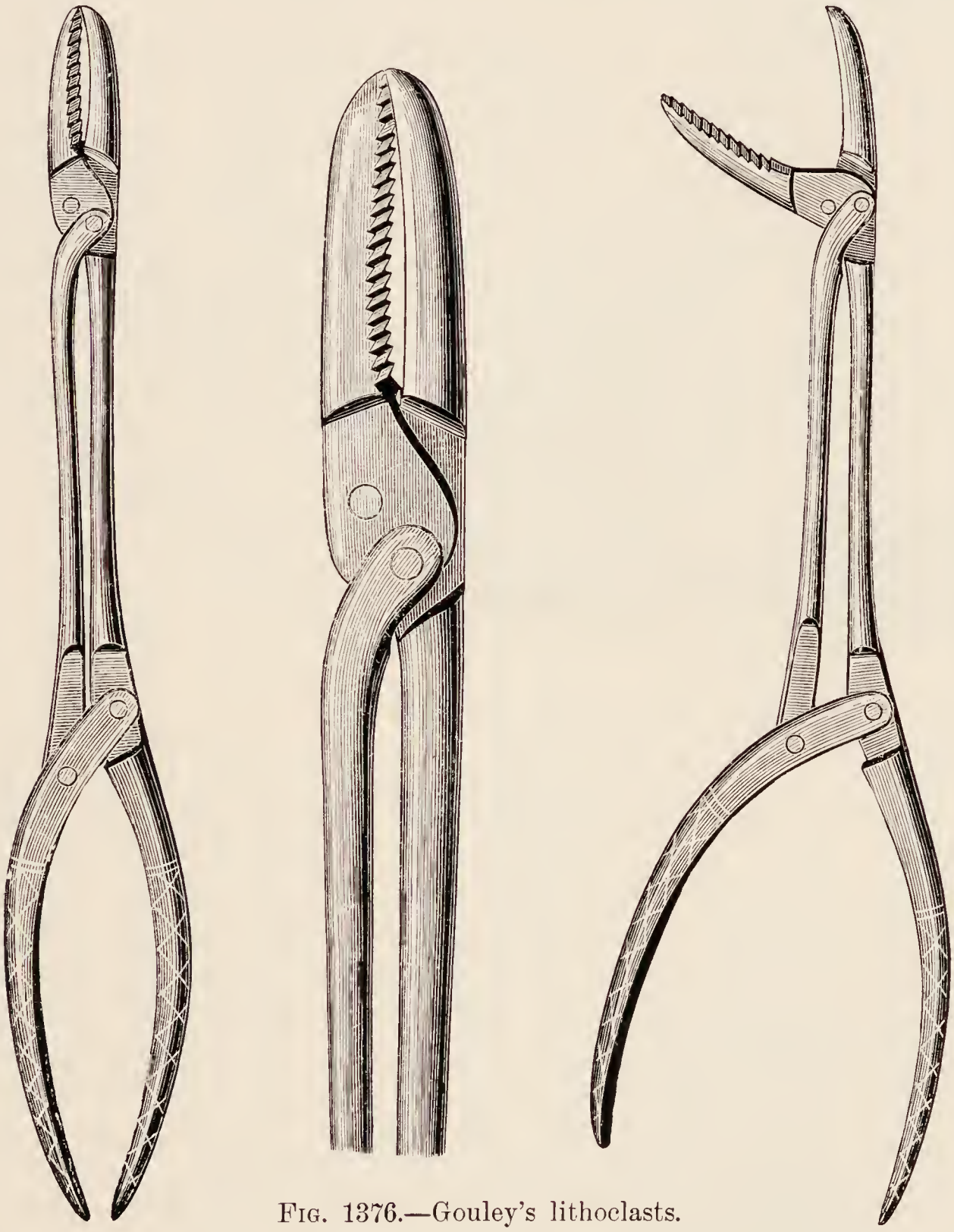


FIG. 1376.—Gouley's lithoclasts.

Because of the presence of the uterus, the posterior wall of the bladder is more irregular and flat than that of the male, and the fragments do not gravitate to the same situation; instead, they are found lower down at the vaginal aspect, and require that the lithotrite be held almost vertically in order to grasp them, rather than at the angle of 45° as in the male. It is sometimes necessary to raise the vaginal septum with the finger so that the stone may be caught. The operation can, however, be readily performed,

and, aside from the variations in the manœuvres necessary to catch the stone, differs but little from that in the male.

Evacuating apparatus can be satisfactorily utilized in these cases, and should be employed when practicable. A short, straight evacuating catheter is the best for use in these cases. Encysted stones and large hard ones should be dealt with by suprapubic lithotomy.

**Lithotomy.**—Lithotomy is the operation for the removal of stone from the bladder by cutting.

The accepted varieties of perineal incision in this operation are the lateral, median, bilateral, and medio-bilateral incisions. The suprapubic incision, variously modified, is now in common use.

*The Anatomical Points.*—The perinæum proper is a triangular-shaped space, the apex corresponding to the center of the pubic arch, the base to a line drawn transversely between the anterior portions of the tuber ischii, and the sides limited by the rami of the pubes and ischium. In the adult male the base of the triangle is from two to three and a half inches in breadth, and the sides from three to three and a half inches in length. The dimensions of the base are of especial interest, since the narrower it is the less oblique lateral incisions can be made. The perinæum is divided into two equal parts by the median rhaphe, the anatomy of each being similar. The left half is the more important, on account of its relation to lateral lithotomy. The bulb of the urethra and the central fibrous point are on the median line, the latter being located about half an inch in front of the anus and just behind the bulb. The internal pudic artery runs along the inner surface of the tuber ischium (Figs. 180, 1331, and 1336), giving off hæmorrhoidal branches and farther along the superficial perineal branches and artery of the bulb. The relation of these several vessels to the cutting operation for stone should be carefully considered before operation is begun. The fasciæ of the perinæum is of great anatomical importance in connection with the course taken by extravasated urine (Fig. 1378). If the extravasation happen between the anterior and posterior layers (*a*, *a*) of the triangular ligament the membranous urethra is at fault, and the extravasation is limited at first to the deep triangular space; if the fluid lie just in front of this ligament, it promptly extends over the scrotum and penis on to the abdomen, but is limited behind and at the sides to the base and borders of the perinæum; it does not extend on to the thighs. If the fluid lie in front of the superficial perineal fascia, it then extends beneath the superficial fascia of the perinæum in all directions. Of course, after suppuration occurs the distinctive importance of the fascial arrangement promptly disappears. In a thin perinæum the base of the

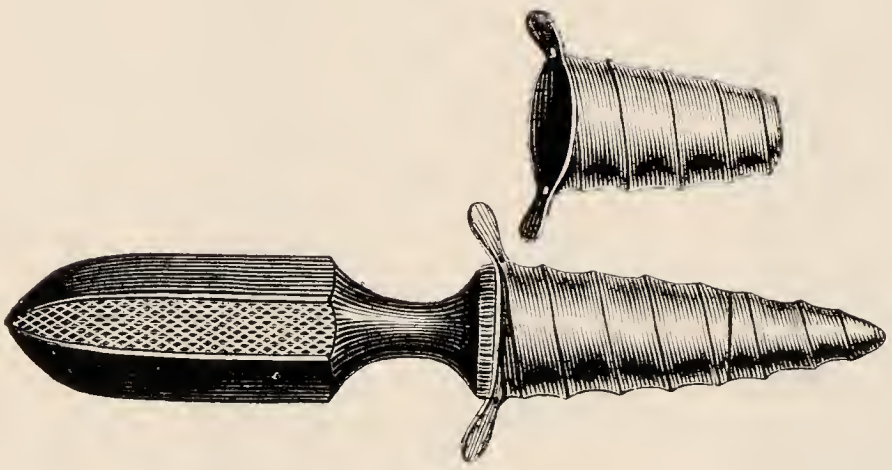


Fig. 1377.—Dolbeau's shield to protect the walls of the wound during crushing.

triangular ligament can be felt on deep pressure just in front of the anus. This is an important perineal landmark, as the membranous urethra lies

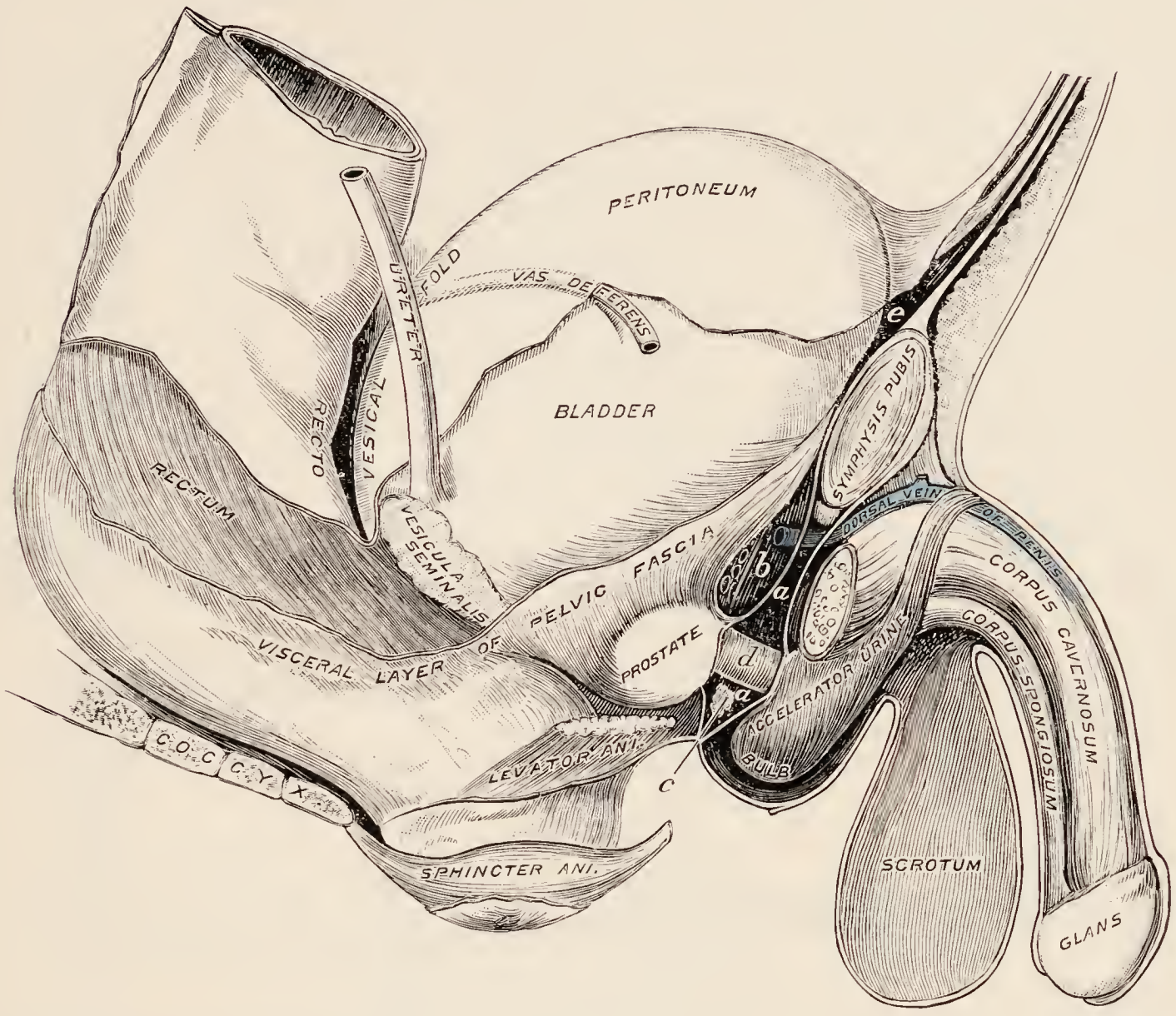



FIG. 1378.—Deep surgical anatomy of perinæum, bladder, etc. *a*, *a*. Space between the superficial and deep layers of triangular ligament. *b*. Space posterior to deep layer of triangular ligament, continuous with Retzius's space. *c*. Cowper's gland. *e*. Retzius's space. *d*. Membranous portion of urethra.

about three quarters of an inch above this point, and about the same distance below the subpubic ligament, as it passes between the layers of the triangular ligament (Fig. 1379). The prostate body is placed in front of the bladder and around the beginning of the urethra. The shape, dimensions, special characteristics, and anatomical relation of it to the bladder and urethra exercise an important influence on the surgical technique of perineal approach to the bladder, and they ought to be carefully studied in an accredited anatomical work before attempting operation. The bladder is about two inches and a half to three inches from the surface of the perinæum, with the patient in the lithotomy position.

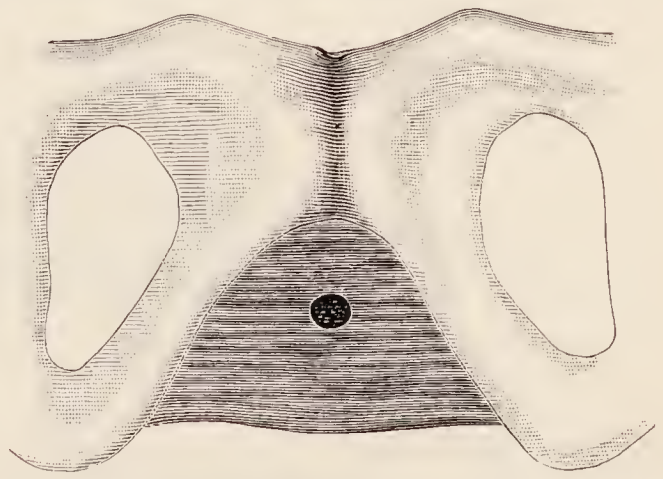


FIG. 1379.—The anterior layer of triangular ligament, showing opening for membranous portion of urethra.

**Lateral Lithotomy.**—Lateral lithotomy is employed when the stone is too large to be easily removed through the dilated prostate. *The special instruments* are a staff of suitable size, with the proper curve and a deep groove upon its convexity which approaches the right lateral aspect as it nears the extremity of the beak (Fig. 1380); a bistoury, with a stout blade and handle, a solid (Fig. 1381) shank, a sharp point, and a cutting edge of about two inches in length; a probe-pointed knife—the one devised by Blizard (Fig. 1382) being the best—and, if the perinæum be deep, due to obesity or other cause, the gorget may be selected (Fig. 1383); a combined scoop and conductor is serviceable (Fig. 1384); forceps of various sizes and shapes to seize the stone, one of which should be arranged with crossed handles to avoid stretching the parts about the neck of the bladder when the stone is grasped (Figs. 1385 and 1386). It is well to be provided with a small lithoclast for the purpose of breaking stones too large to be extracted

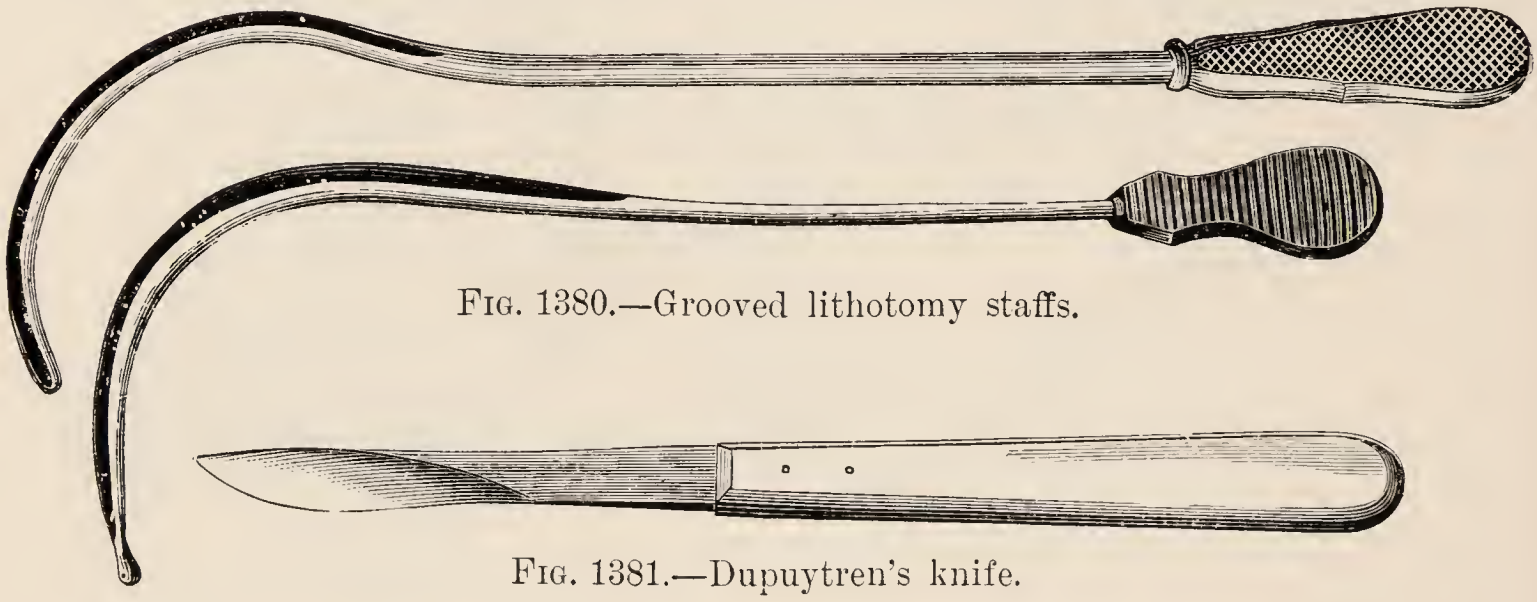


Fig. 1380.—Grooved lithotomy staffs.

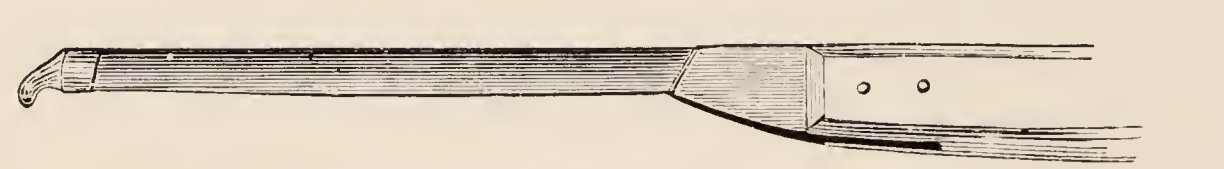


Fig. 1381.—Dupuytren's knife.



Fig. 1382.—Blizard's knife.

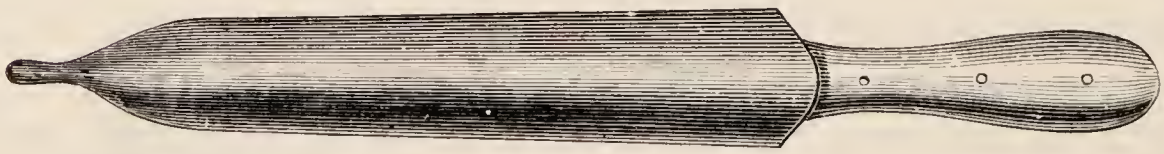


Fig. 1383.—Blunt gorget.



Fig. 1384.—Scoop and conductor.

with safety, a scoop to dislodge the remaining fragments of stone (Fig. 1387), and a syringe to wash from the bladder any small fragments that may remain

(Fig. 1388). Davidson's syringe can be used, but is less satisfactory than one designed for the purpose. The chemise or shirted and the air-bag cannula (Figs. 1389, 1390, and 1391) are useful to control hæmorrhage. At least five assistants should be present. To one of these the staff should be intrusted; the lower limbs may be controlled by two others, either with or without the limbs being confined by the anklets (Fig. 1392). The hands and feet may be bandaged together satisfactorily for the purpose. Of the remaining assistants, one should attend the instruments and the other the sponges, etc.



FIG. 1385.—Straight forceps.



FIG. 1386.—Curved lithotomy forceps.

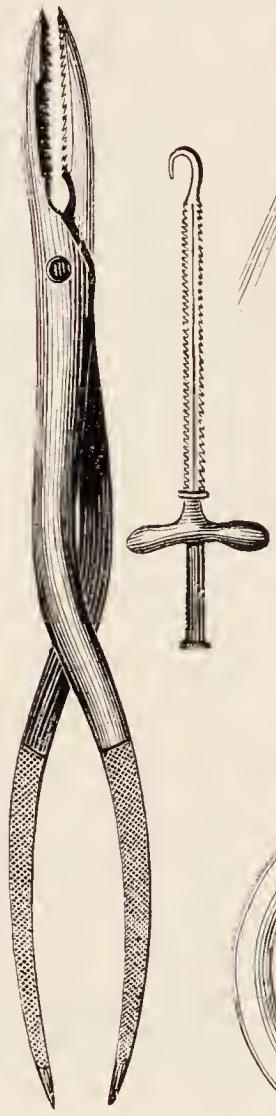


FIG. 1387.—Dolbeau's lithoclast.

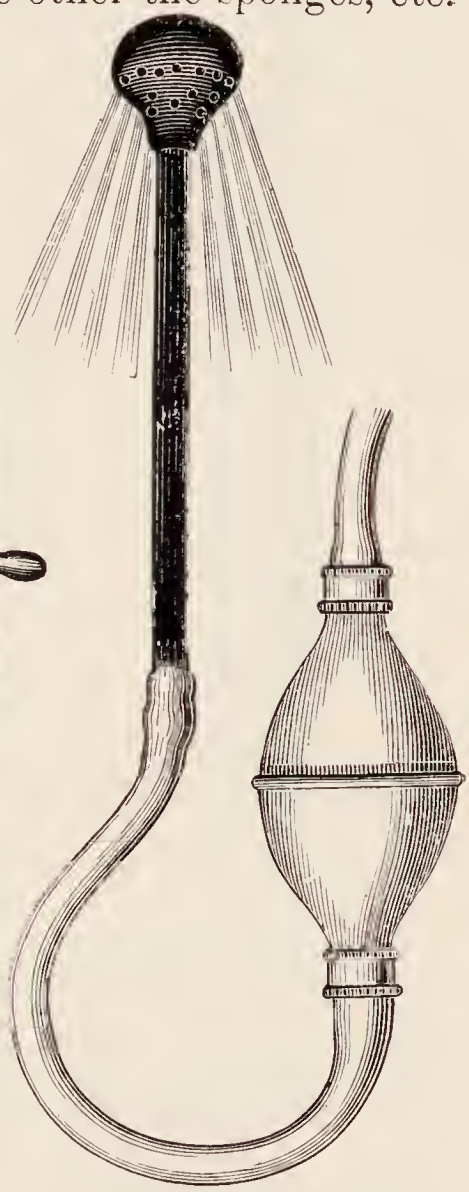


FIG. 1388.—Van Buren's *débris* syringe.

The more modern device for separating the lower limbs and exposing the perinæum will be found of great service (Fig. 1393). Forcipressure, retractors, ligatures, wipers, and drainage tubes, should be at hand.

*The Preliminary Steps to the Operation.*—Rest in bed for two or three days before operation, or, at the least, long enough to ascertain the condition of the kidneys, as indicated by the amount and character of the urine, is very important. The cleansing of the bladder with an aseptic fluid should be practiced during this time if the urine be offensive or much vesical irritation be present.

Shave and disinfect the parts, empty the rectum with an enema, administer an anæsthetic, draw the patient down to the edge of the table, and control the lower extremities by bandaging them to the upper, or give each one in charge of an assistant.

The staff is introduced and the stone found—a fact that should be verified by others present. If the stone be not detected the staff should be withdrawn, and its presence and location determined by the searcher. These points must likewise be confirmed by others. If the stone be not found at all, the operation must be deferred.



Fig. 1389.—Chemise cannula.

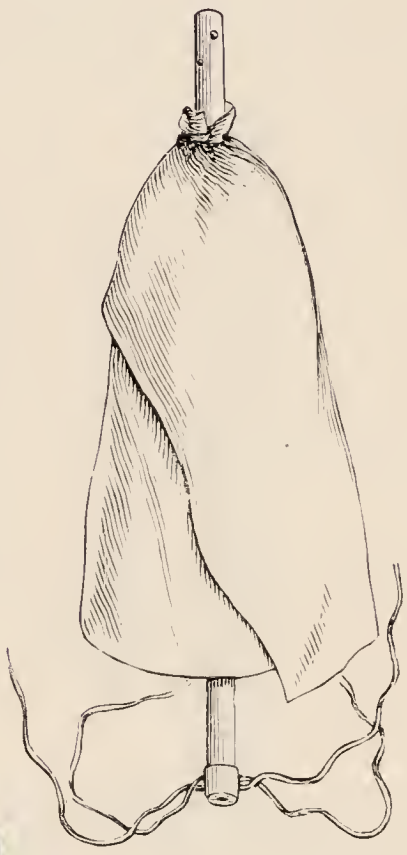


Fig. 1390.—Chemise catheter.

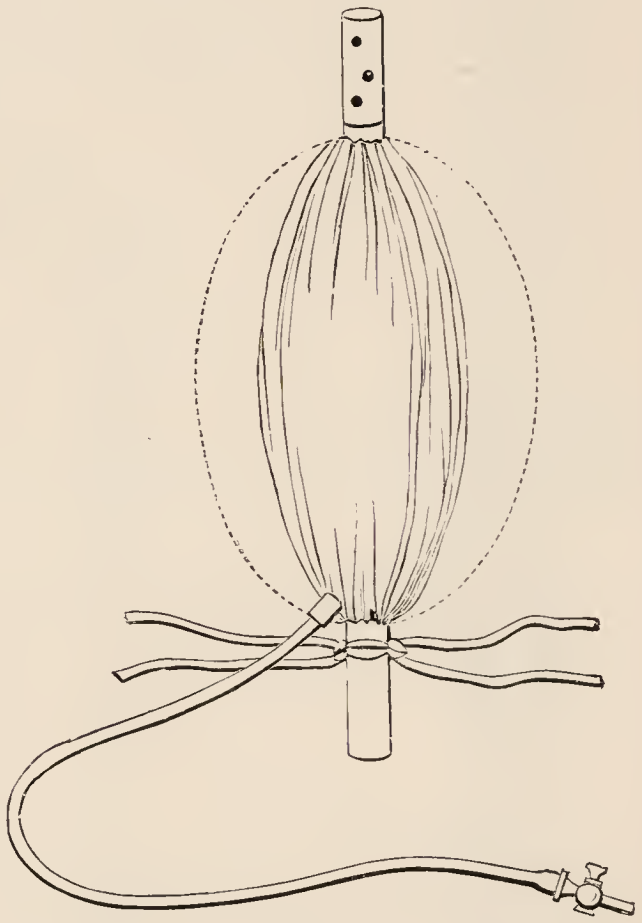


Fig. 1391.—Browne's air tampon and cannula.

The principal assistant, who holds the staff, should satisfy himself that the sound is in contact with the stone, although it is not necessary that it be pressed against it during the operation. The holder of the staff should stand at the patient's left and hug it firmly beneath the pubes with the right hand, while the integument of the perinæum is made tense by drawing up the scrotum with the left. The convexity of the staff should be easily felt in the perinæum. If the perinæum be thin the groove may be distinctly defined with the finger. Some surgeons have advised that the staff be pressed against the perinæum, instead of the pubes, that the outline may be the better defined. However, it is a matter of little importance which course is taken, as long as

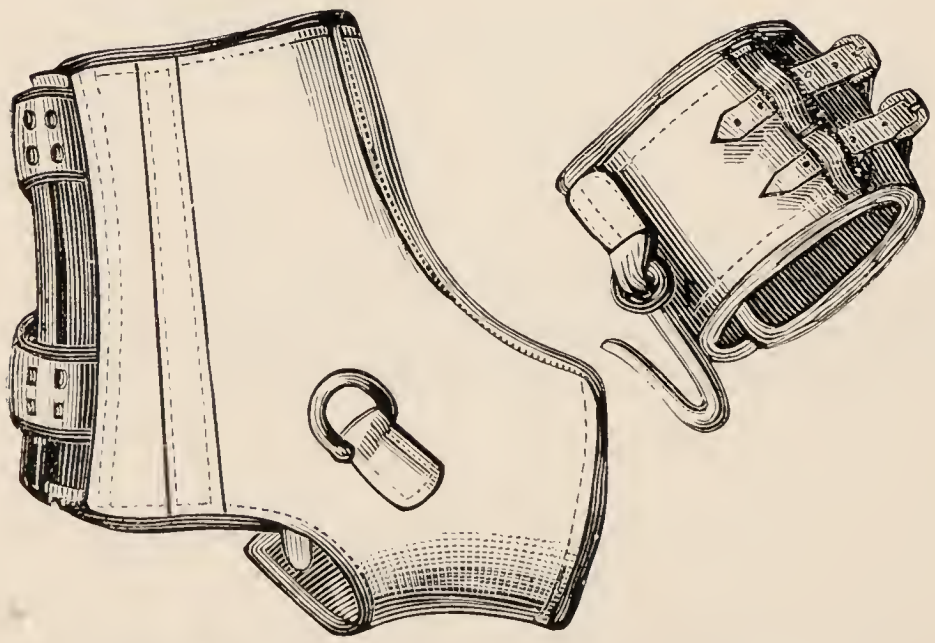


Fig. 1392.—Pritchard's anklets and wristlets.

the pubes are hugged by the instrument while the incision is being made into the bladder. The surgeon should sit upon a low stool, and, before beginning the incision, carefully map out the location of the bulb and the point where the incision is to begin, also determine the outlines of the rami and tuber ischii. He then introduces the index finger of the left hand into the rectum, locates the apex of the prostate, and determines its relations to the sound. The finger is withdrawn, thoroughly cleansed, and the groove in the staff again located.

*The Operation.*—The incision is commenced a little to the left (one third of an inch) of the median rhaphe, from an inch and a quarter to an inch and a half in front of the anus (Fig. 1402, *b*). The point of the knife is made to enter the groove at the second or third cut, being guided there by the nail of the index finger of the left hand. The perineal incision is made obliquely

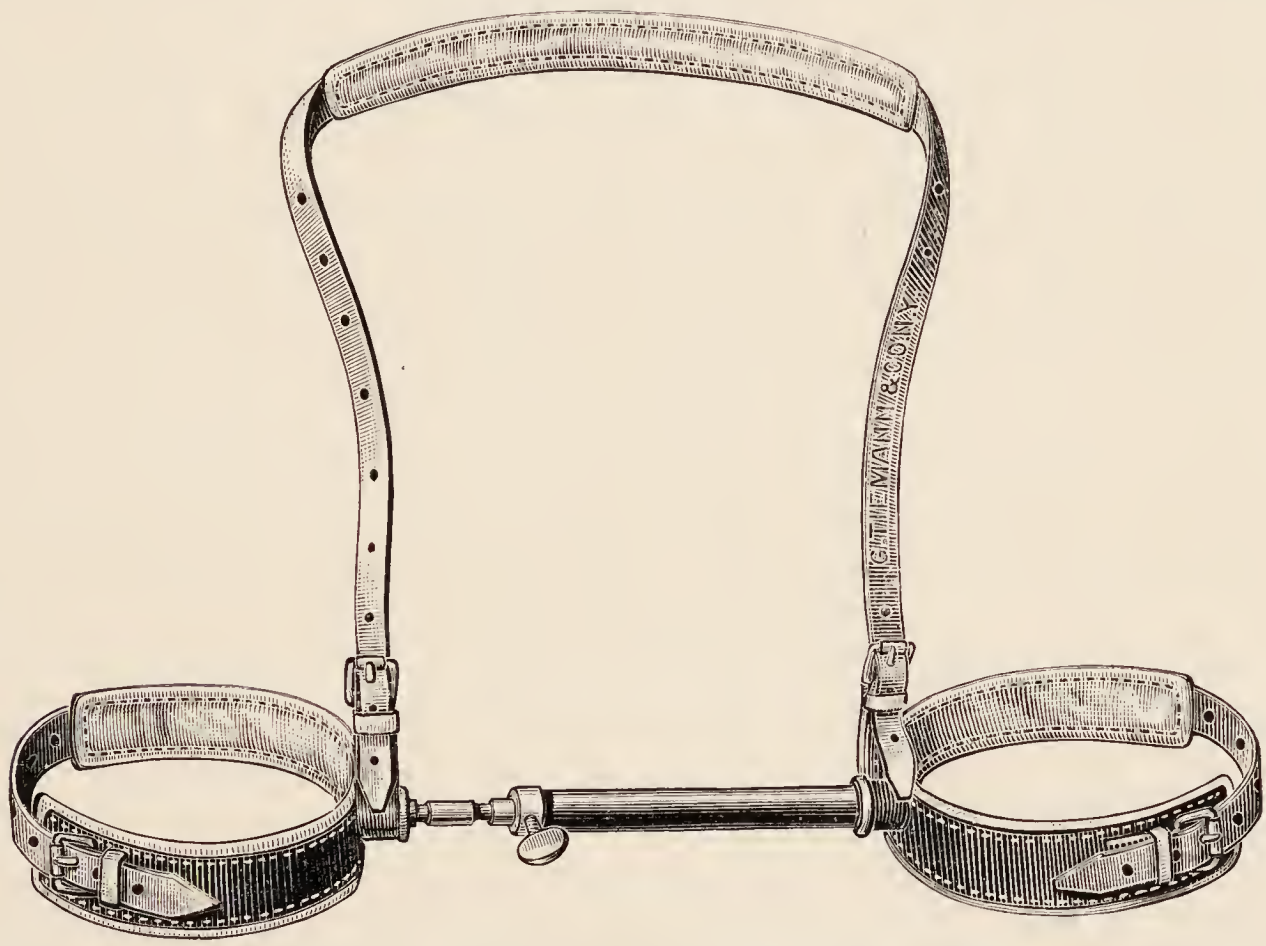



Fig. 1393.—Clover's crutch to hold the legs (Fig. 1402), with strap to go over the shoulders.

downward from three to three and a half inches in length, *midway between the tuber ischii and the verge of the anus.* It is deep above and should be shallow below. The urethra is then freely opened, and the probe-pointed bistoury substituted for the scalpel; or the blunt extremity of the Blizard (Fig. 1382) or another suitable knife is engaged in the groove, when the surgeon, taking the handle of the staff in the left hand, draws it downward somewhat, and then, holding it firmly, carries the point of the knife along the groove toward the bladder in the line of the perineal incision, depressing its handle slightly to correspond to the curve of the staff. As soon as the end of the knife is stopped by the termination of the end of the groove in the staff its handle is depressed, the edge turned outward still more, and the deep tissues severed from within outward by its withdrawal, care being taken to make the incision through the prostate more horizontal than that of the perinæum

(Fig. 1394). The flow of urine which follows assures the operator of successful entrance to the bladder.

It is recommended to press the point of the scalpel firmly against the groove in the staff with the right hand, seize the staff with the left, depress the handle of the staff and the knife at the same time, to the same extent, and thus convert them for the moment into one instrument which is pushed into the bladder. This plan is often practiced, and when carefully done will prevent the escape of the point of the knife from the groove. It is more difficult, however, to properly lateralize the knife in its passage through the prostate in this than by the former method; besides, it is a less elegant act. *The asepticized* index finger of the left hand is now passed carefully into the bladder along the staff, which is then withdrawn. The neck of the bladder is dilated by the finger, the stone reached, and its diameter estimated, if it has not been done before. The closed forceps (Fig. 1385 or 1386) is now passed into the bladder along the finger as it is withdrawn, and the stone carefully sought for and grasped in the short diameter, if possible. If one blade of the opened forceps be pressed upon the floor of the bladder, the stone will often roll promptly within its grasp. However this may be, unusual caution must be employed in the manipulation, so as not to bruise the contracted walls of the viscus. If the stone be grasped in its long axis it should be dropped and the position corrected by the finger carried into the bladder. The change in the direction of the long axis of the stone may sometimes be accomplished by carrying two fingers into the rectum, separating and pressing them upward against the bladder, thereby compressing its sides and creating a furrow running antero-posteriorly into which the stone will drop correspondingly. When properly grasped the stone is withdrawn by steady traction made in the axis of the floor of the pelvis and in the line of the perineal incision. As soon as the calculus is removed, its surface is examined for facets, which will indicate the presence of one or more calculi still in the bladder. Having removed the calculus, irrigate the bladder with warm aseptic fluid to remove all blood clots and whatever detritus may be present. If there be earthy matter in the bladder it may be necessary that it be removed with a scoop.

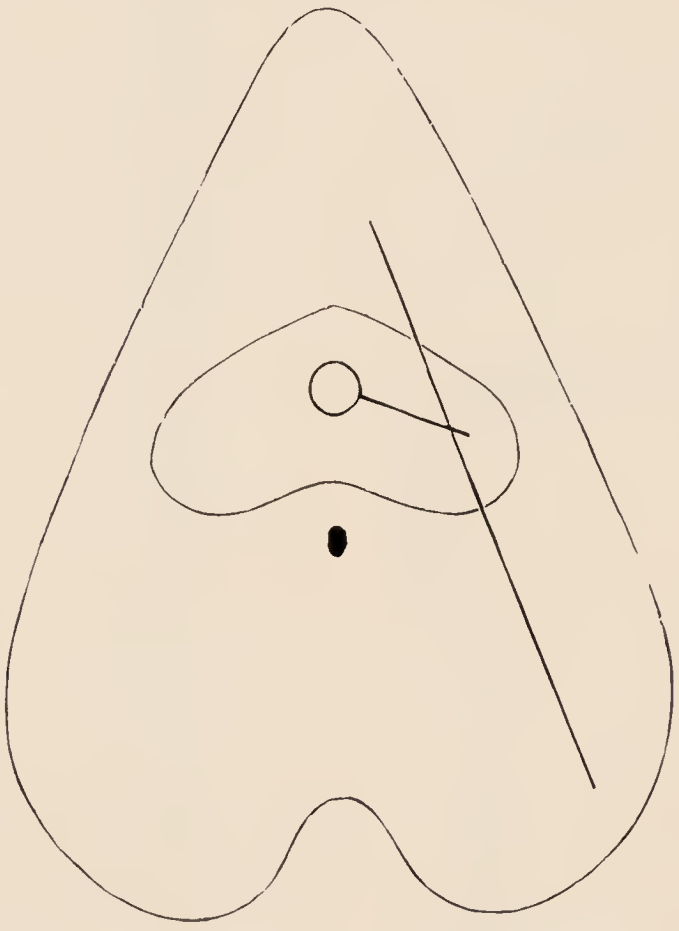


Fig. 1394.—Lateral incision of prostate and perinæum.

**Lateral Lithotomy in Children.**—Lateral lithotomy in children is modified somewhat on account of their relatively different normal anatomical state.

*The Anatomical Points.*—The pelvis is small; the bladder is high in the pelvic cavity, freely movable and insecurely fixed; the urethra is small and thin, hence the more readily torn; the prostate is undeveloped and the neck of the bladder correspondingly exposed to division, which, if too extended, may involve the pelvic fascia. However, the perinæum is thin and the bulb diminutive, therefore the staff can be easily felt. The high position of the bladder enables the surgeon to control it well by abdominal and rectal palpation.

*The Precautions.*—Note that the instruments are of proper size and that gentleness of manipulation be practiced. A too forcible effort at introduction of the fingers may push the bladder upward in front of them or tear the prostate. A forcible dilatation of the neck of the bladder is therefore to be avoided, and relatively free incision made instead.

*The operation* in the child differs in no important regard from that in the adult, except that the incision into the bladder is made relatively freer and the vesical wound is dilated carefully with dressing forceps instead of with the fingers, at the outset. If greater capacity be needed the forceps are removed and a small probe is introduced as a guide to the finger, which is then carefully insinuated along the probe into the bladder. First the little, then the index finger can be introduced if required. The stone is removed in the usual manner with forceps or a scoop, aided by the finger in the bladder or rectum.

*The General Precautions.*—In lithotomy the incision should be carefully laid out and cautiously made to avoid cutting the bulb and its artery above, or the rectum and internal pudic below. The point of the cutting instrument must be surely lodged and kept in the groove of the staff, or it will go astray, doing great damage and misleading the surgeon. The handle of the knife should be depressed as the point moves forward in the groove, or the point will leave the staff. If the handle be depressed too much, the point of the knife will be fixed in the groove and further advance prevented until the direction is rectified. If the staff enter a false passage unnoticed the surgeon is misled, the incision misplaced, and perhaps irretrievable injury done. The careless holding of the staff often perplexes and may confuse and mislead the operator. The staff should not be withdrawn until the finger or a probe have been passed along the groove into the bladder, otherwise the lines of incision may be lost and much difficulty experienced and care required to find it again. If the incision be too small the tissues will be torn by the extraction of the stone; room can be gained by dilatation or by repeated incisions made in the line of the first one, or at the opposite side. If the incision be made too far posteriorly the ejaculatory ducts will be cut. A too free incision of the neck of the bladder will cause urinary infiltration of the pelvic fascia. Too great traction on a stone will tear the neck of the bladder, perhaps beyond the limits of the prostate, causing infiltration and sepsis. A lateral incision of the neck of the bladder in the adult should be limited to the extent of the prostate (three quarters of an inch).

*The General Remarks.*—In lithotomy if the stone be encysted it is very difficult and often impracticable to remove it. It may be possible to grasp

an exposed portion with forceps with or without division of the confining structure, and in either instance great care and judgment must be exercised. An irregular contraction of the bladder may cause entanglement of a stone. But pressure upon the fundus, supplemented with digital touch and the employment of large forceps, will meet the contingency. Vigorous traction on the short axis of a long stone pulls the bladder downward so as to expose the prostate at the perineal wound if continued. Lateral movements with traction, when slowly made, will facilitate the removal of a calculus without contributive danger. If a stone be too large for safe removal it should be crushed and removed piecemeal.

*The Complications.*—The complications can be rationally divided into the concomitant and consequent varieties.

A deep perinæum due to corpulency, enlargement of the prostate, the presence of tumors in the bladder, and post-prostatic encystment of the stone, preventing the grasping of the calculus, are not infrequent concomitant complications.

Among the *consequent complications* are wounding of the bulb, the rectum, or the bladder. The latter viscus may be severely wounded by puncture with the staff, the slipping of the knife from the groove, etc. Laparotomy and closure of the wound should be promptly practiced in those

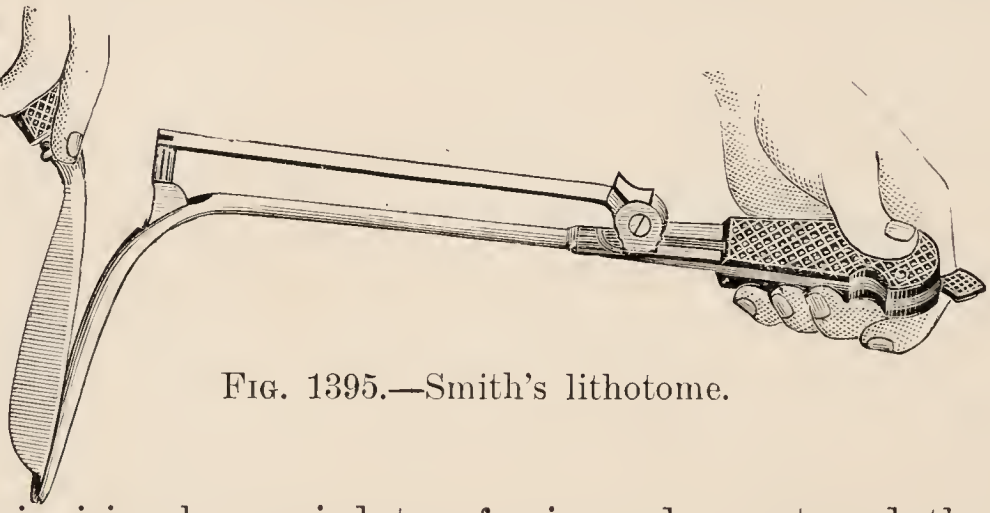


Fig. 1395.—Smith's lithotome.

cases. If the incision be carried too far inward or outward the rectum or the pudic artery may be cut respectively, and if begun too far from the anus or at the median line the bulb will suffer. If the penis be drawn forward on the staff, and the staff be raised against the pubic arch as the urethra is being opened and the incision extended, the bulb is drawn away from the course of the knife. Breaking of the stone seems a trivial complication, but may be very annoying before the fragments are all removed. The inability to find the stone after making the incision is perplexing, which may depend on a false passage, a hidden calculus or its unobserved escape with the first gush of urine, or possibly on a mistaken diagnosis. Incontinence and retention sometimes occur. Hæmorrhage at the time, or shortly after the operation, is a troublesome and sometimes fatal complication. If arterial hæmorrhage occur, catch and tie the bleeding point if practicable; the bleeding may be checked by ice pressure or by the use of a hot-water-bag tampon; if these be inadequate for the purpose, forcipressure may be applied to the bleeding point and allowed to remain for twenty-four hours. The tying in of a tenaculum or the use of acupressure may be feasible. Venous

hæmorrhage can be controlled by the chemise catheter (Figs. 1390 and 1391), the air-bag tampon, or by some other similar expedient. Prostatic phlebitis followed by thrombosis and sepsis sometimes follow, either originating from the primary wound or caused by the steps essential to the arrest of severe, deep-seated hæmorrhage. Suppression of urine due to kidney disease is a danger not to be disregarded.

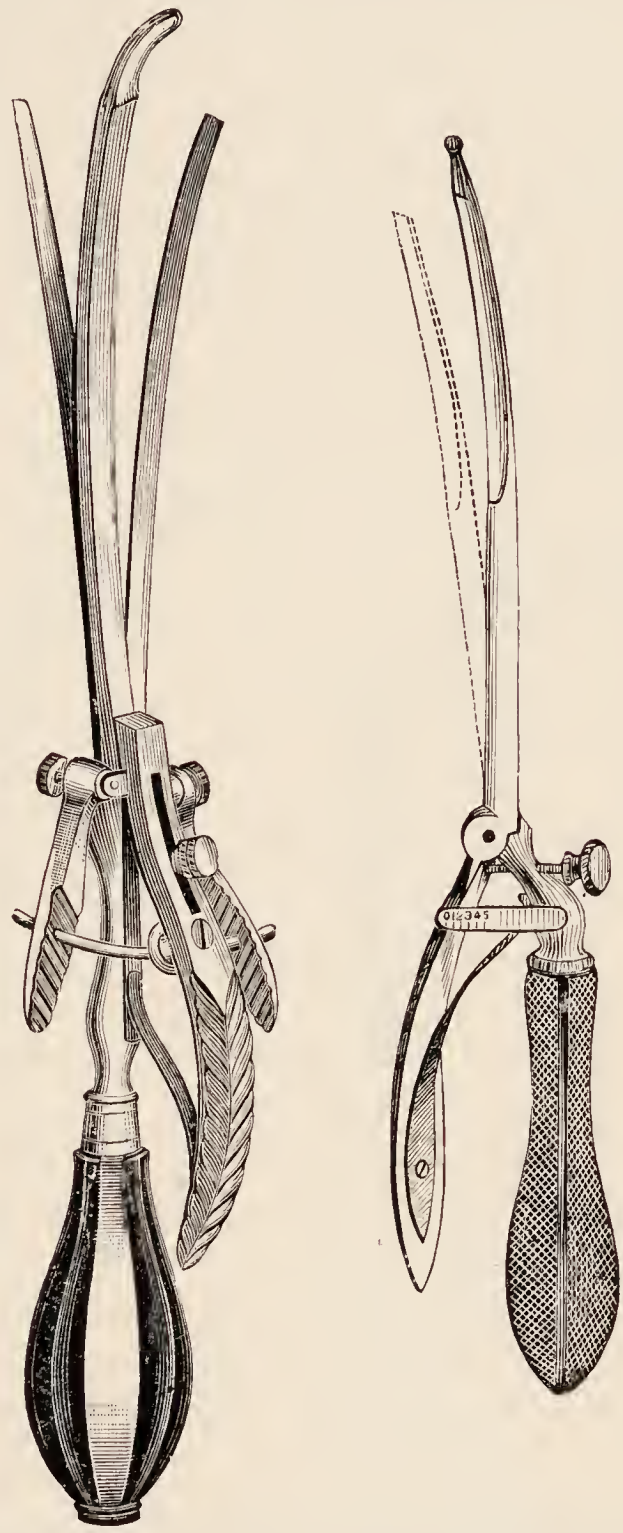


Fig. 1396.—Dupuytren's double lithotome.

Fig. 1397.—Hutchinson's single lithotome.

While the preceding technique of the operation is that usually employed, still there are instrumental modifications which, in the opinion of some, may lessen the dangers of the operation in inexperienced hands. The instrument devised some years ago by Smith, of Baltimore, and successfully employed by him and others (Fig. 1395) is worthy of mention. It consists of a rectangular staff with a well-rounded angle, deeply grooved on its horizontal portion, and provided with an indicator attached to the shaft by means of a hinge. The indicator is likewise rectangular, and terminates in a lance-shaped blade. The indicator can be adjusted by sliding it up and down the staff; or various sizes of the instrument may be employed to meet individual differences. The staff is introduced and held by an assistant in the usual manner, and the cutting extremity of the indicator is applied to the median line and pushed through the tissues until it lodges in the groove of the staff. The probe-pointed gorget is then passed into the groove and lodged in the channel on the staff, along which a cut is made into the bladder. A probe-pointed bistoury may be substituted for the gorget. *The use of the double and single lithotomes* (Figs. 1396 and 1397) were advocated formerly more frequently than at the present time. But then as now, however, their advocates were small in number as compared with the adherents of the use of the scalpel and grooved staff.

*The After-treatment.*—After the operation place the patient in bed with a rubber cloth beneath the hips, separated from the body by cloths and

sponges, to collect the urine and indicate the occurrence of hæmorrhage. The temporary introduction of a catheter or drainage tube into the bladder through the wound in the perinæum is practiced often, especially if the patient has suffered from cystitis with infected urine. Under these circumstances the tube should not be omitted for three or four days, and even longer if the discharge be offensive or a tendency to retention be present. If the tube become blocked the obstruction should be removed by a probe, an aseptic feather, or a stream of water, and perhaps be removed entirely and cleansed. If a long silver probe be carried through the tube and allowed to remain, after removal it will be of great service in returning the tube to the former position. Give light and stimulating diet, alkaline drinks, and treat all sequelæ on general principles.

*The Results.*—The rate of mortality varies from 6 to 10 per cent.



FIG. 1398.—Little's lithotomy staff.



FIG. 1399.—Markoe's staff.

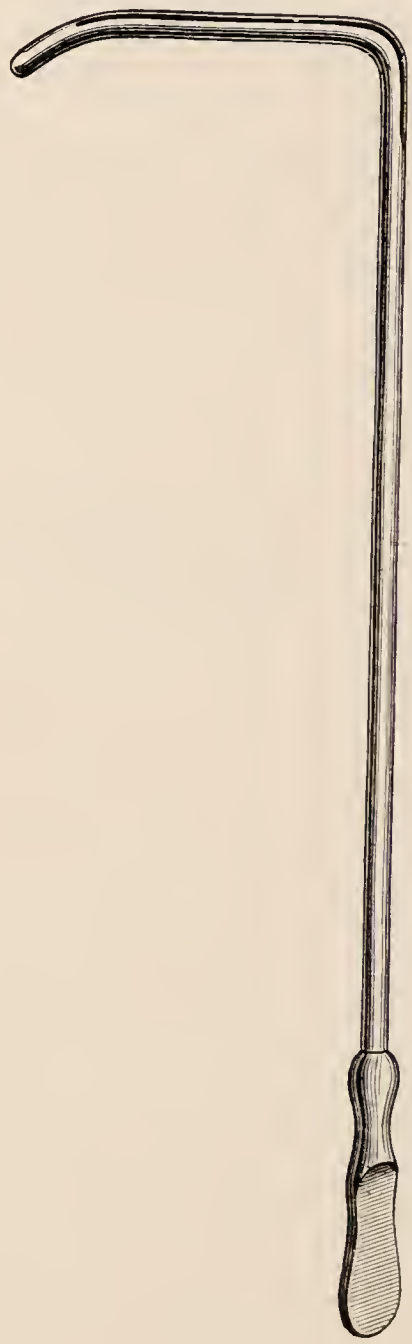


FIG. 1400.—The rectangular staff.

**Median Lithotomy.**—Median lithotomy is applicable to cases having one or more small stones half an inch or so in diameter, and in advancing puberty for prostatic calculi and for small calculi with offensive cystitis. In

this method there is less danger from hæmorrhage, much better control of the urine from the first, and the wound heals rapidly. If the stone be larger than is anticipated, the temptation to use undue violence during the extraction is great. It is claimed that this method may be followed by stricture of the urethra, and also that the mouths of the seminal ducts are more likely to be injured by extraction of the stone than in the other methods. However, the exposure of the ducts to injury by cutting is eliminated in this method.

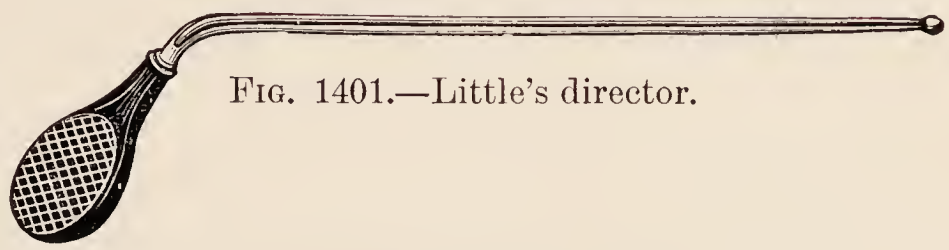


Fig. 1401.—Little's director.

*The general precautions* to be employed in all forms of lithotomy are mentioned fully in connection with the lateral operation (page 1844 *et seq.*).

*The instruments* are the staff, director, and knife. The staffs vary somewhat in the shape and depth of the grooves. The ones devised by Little (Fig. 1398) and Markoe (Fig. 1399) leave nothing to be desired. The rectangular variety (Fig. 1400) can be used in lieu of the curved one, although it has been infrequently employed in this country. The director devised by Little is an admirable instrument (Fig. 1401), but is by no means alone essential to successful operation. A stout, straight, sharp bistoury, double-edged at the point for making the perineal incision, makes the especial outfit complete.

*The Operation.*—Confine the patient in the lithotomy position (Fig. 1402); introduce the staff, placing the end of the beak in contact with the stone; pass the left index finger into the rectum and locate the apex of the prostate just where the staff enters it; introduce the point of the knife into the median line of the perinæum half an inch in front of the anus (*a*), with the long cutting edge uppermost, and push it carefully upward to the apex of the prostate, guided by the finger in the rectum, into the groove of the staff. The knife is advanced sufficiently toward the bladder to nick the apex of the prostate, after which it is carried forward to divide the membranous portion of the urethra. The external incision should be from an inch and a quarter to an inch and a half in length, care being taken to avoid the bulb of the urethra. The director is then passed into the bladder along the staff, and the neck of the bladder moderately dilated by separating the two from each other. The staff is then withdrawn, and the asepticized index finger of the left hand is carried through the neck of the bladder along the director with a semirotary motion to complete the dilatation. The forceps is then introduced, the stone caught at its short diameter, and removed by steady, gradual traction, which may be accompanied by rocking movements, but never by a rotation of the instrument on its long axis while grasping the stone.

Various instruments have been devised to dilate the prostate in this and other methods calling for the procedure, all of which when carefully employed answer the purpose well, but are by no means essential to a safe performance of the operation. After the removal of the stone, arrest hæm-

orrhage, seek for any remaining calculi, and otherwise treat the patient as indicated in the lateral operation.

*The Remarks.*—The small size of the perineal opening in children may interfere with the proper removal of the calculus. Care in the avoidance of

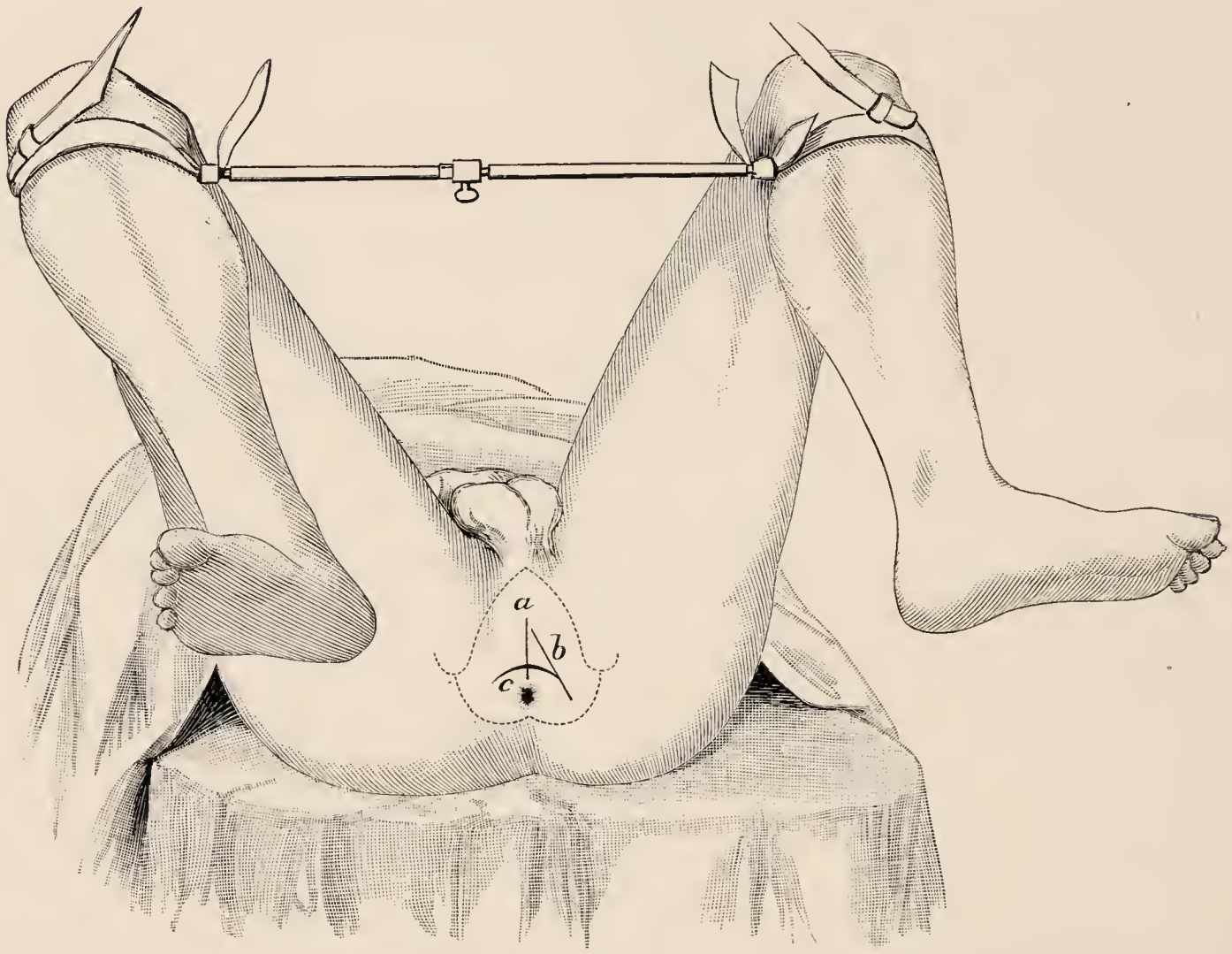



Fig. 1402.—Lines of incision in perineal lithotomy, showing Clover's apparatus applied. *a*. Incision in median lithotomy. *b*. Incision in lateral lithotomy. *c*. Incision in bilateral lithotomy.

injury of the bulb and the rectum is especially needful in this operation. Inasmuch as the operation is suited only for the removal of small stones, which usually can be better done by lithotrity, the procedure is now comparatively rarely practiced.

*The Results.*—The death rate is from 4 to 8 per cent.

**The Bilateral Lithotomy.**—The preliminary preparations, the precautions, and general arrangements in this are similar to those necessary in the other methods. The special instruments are the grooved staff and the bisector, so intimately associated with the name of the late James R. Wood (Fig. 1403), or the lithotome of Dupuytren or Briggs (Figs. 1396 and 1404).

*The Operation.*—Make a semilunar incision across the perinæum, three fourths of an inch in front of the anus, beginning midway between the anus and the tuberosity on the right side, and terminating at a similar point on the opposite side (Fig. 1402, *c*). The convexity of the cut is directed forward. The several tissues are divided down to the membranous urethra, which is opened, and the beak of the instrument is inserted in such a manner as to cause the beveled edges of the bisector to be uppermost. After moving the beak backward and forward, to be certain that it is well lodged in the groove, it is then firmly pressed against the groove of the staff, and, with the

staff held firmly, it is carried into the bladder. The staff and cutting instrument may be, practically, converted into a single instrument by pressing them firmly together and carrying them inward at the same time, being careful to depress simultaneously the handle of each to the same degree.

*The Precautions.*—The cutting instrument may be carried behind the bladder if any tissues exist between the groove and its probe-pointed extremity, or its handle be not depressed so as to keep the beak in the groove of the staff. The anterior wall of the rectum may be cut while making the crescentic incision, if directed too much downward. This accident can be avoided by inserting the index finger of the left hand into the bowel when the primary incision is being made, and drawing the anterior wall backward while the cut is being completed.

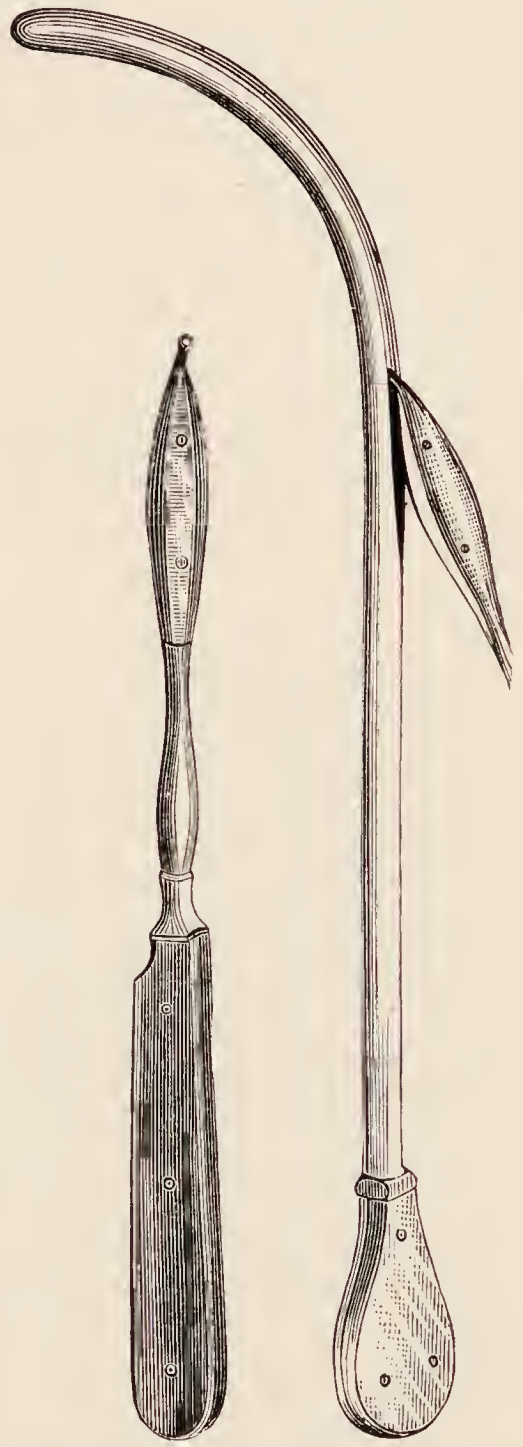


Fig. 1403.—Wood's staff and bisector.

*The results* obtained by this method in the hands of Dr. Wood were equal to, if not better than, those previously given in connection with the other methods of cutting for stone.

*Nélaton's Modification.*—Nélaton modified the first step of the bilateral method with the view of lessening the danger of cutting the bulb and the wall of the rectum. He introduced the left index finger into the rectum, placed the end of it against the apex of the prostate, and steadied the anterior border of the anus with the thumb of the same hand. He then made a semilunar incision in front of the anus, the extremities of which were four fifths of an inch from the anus at either side, and the greatest convexity three fifths of an inch from it. The dissection was continued, layer by layer—the wall of the rectum and the bulb being carefully avoided—until the membranous urethra was reached and opened, and the cutting instrument introduced. The same object was accomplished through a transverse incision an inch and a quarter in length, with its center located three fifths of an inch in front of the anus.

**The Medio-lateral Lithotomy.**—This method was introduced by *Buchanan*, of Glasgow.

The necessary instruments are a rectangular staff with a broad groove at the left side, and a narrow, straight knife with a long cutting edge. The staff is introduced, and the prominent staff angle adjusted to correspond to the muco-cutaneous junction on the anterior verge of the anus in the median line.

The staff is firmly held with the handle inclined toward the abdomen, and the overlying tissues are penetrated by the knife, held horizontally and

with the edge turned to the left, until the groove in the staff is reached; then the knife is pushed forward into the bladder upon the staff. As it is withdrawn, an incision three fourths of an inch long is made downward and outward toward the fore part of the tuber ischii. This incision is completed by being continued directly downward about half an inch. If necessary it can be extended.

*The Results.*—A little over 10 per cent are reported to have died from operation by this method.

**The Medio-bilateral Lithotomy.**—The medio-bilateral operation was brought to the notice of the profession by Civiale, and afterward was championed in this country by Briggs, of Nashville. The staff for the median

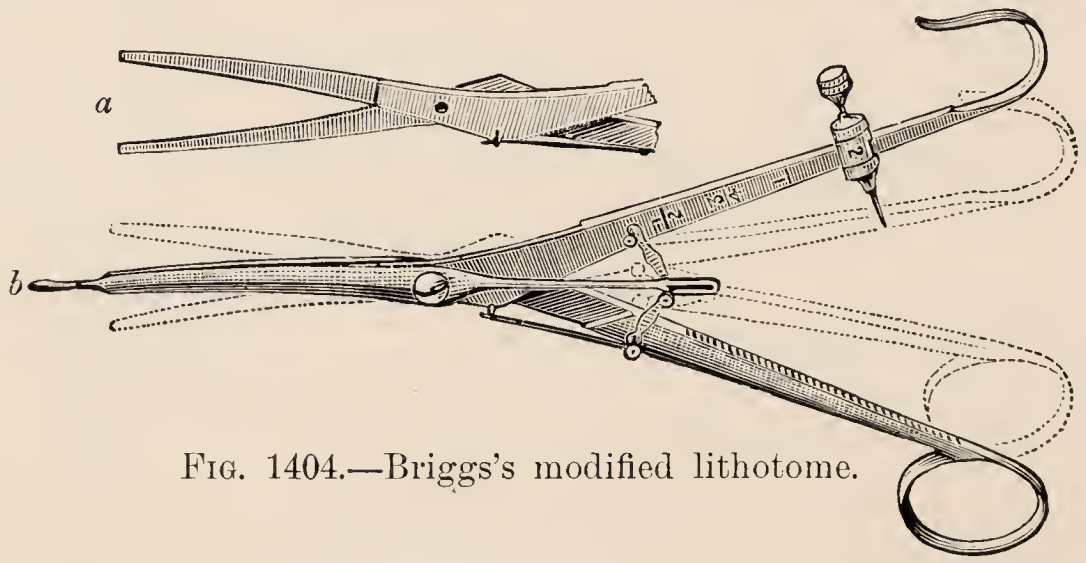



Fig. 1404.—Briggs's modified lithotome.

method is introduced with the patient placed in the usual position; the rectum is drawn backward by the finger, and an incision is made through the median line into the staff an inch and a half in length, beginning about half an inch in front of the anus.

The lithotome (Fig. 1404, *a*) is then introduced into the groove, carried into the bladder, the blades are separated half an inch, limited by the pointed slide on the handle, and the instrument is withdrawn, thus dividing the prostate, and enlarging the wound on either side a quarter of an inch throughout. The wound is then dilated and the stone removed in the usual manner. If too large it may be crushed. The writer modified Briggs's instrument somewhat by introducing an independent guiding stem which steadies the cutting blades during the withdrawal of the instrument from the bladder (Fig. 1404, *b*).

*The Results.*—Briggs reported the mortality as 1 in 37 cases, which is certainly an astonishing result.

**Suprapubic Lithotomy.**—The suprapubic or high operation was done near the middle of the sixteenth century. Since this time it has found favor at several epochs, and is now again being strongly advocated and quite generally practiced. The various relapses of the method depended, without doubt, more upon the determination of its exponents to make it an exclusive operation than upon its own intrinsic defects.

The following conditions call for the employment of this method: great prostatic hypertrophy; inability to extract the stone through the perinæum on account of its size; encysted stone; large stone with a contracted bladder surrounding it firmly; impermeability of the urethra. The method permits

of a complete inspection of the bladder, obviates all danger of injury of the structures of the neck of the organ, and establishes the wound in a favorable site for cleanliness.

*The Anatomical Points.*—The median line of the body at this situation can be determined by measurement and by palpation. The symphysis pubis and the suprapubic notch are infallible bony guides to the lower limit of the median line, and can be easily located, except in cases with marked adipose deposit. The linea alba at this situation is frequently too indistinct to be relied upon as a guide. The pyramidal muscles located beneath the sheath of the rectus should not be mistaken for the rectus. The direction and marked development of their fibers, and their superficial location should make their recognition easy. The suprapubic notch can, at this time, be readily felt, and will indicate the lower limit of the median line positively. The separation of the borders of the pyramidal muscles and the lower extremities of the recti abdominis and the divided borders of the transversalis fascia—lying immediately beneath the latter—from each other, will open directly into the anterior limit of the space of Retzius, otherwise known as the prevesical space (Fig. 1378, *c*, *b*). The prevesical space lies between the bladder

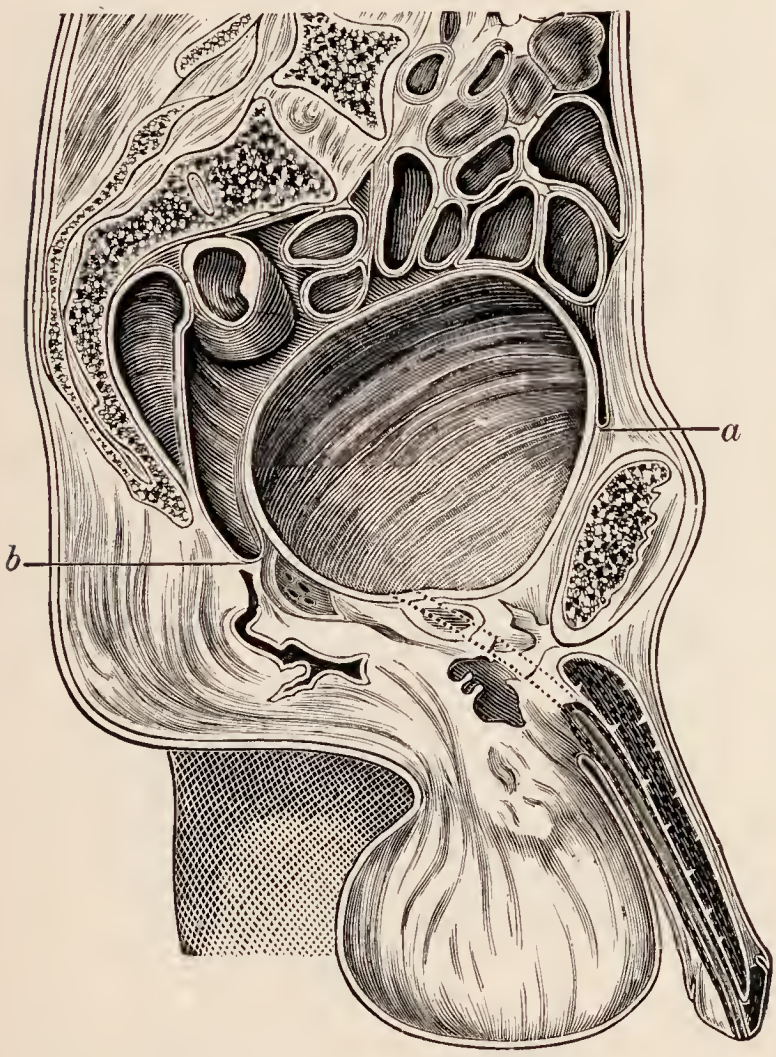



Fig. 1405.—Cut from frozen section. Bladder contains ten fluid ounces. *a*. Prevesical fold of peritonæum. *b*. Retrovesical peritoneal fold.

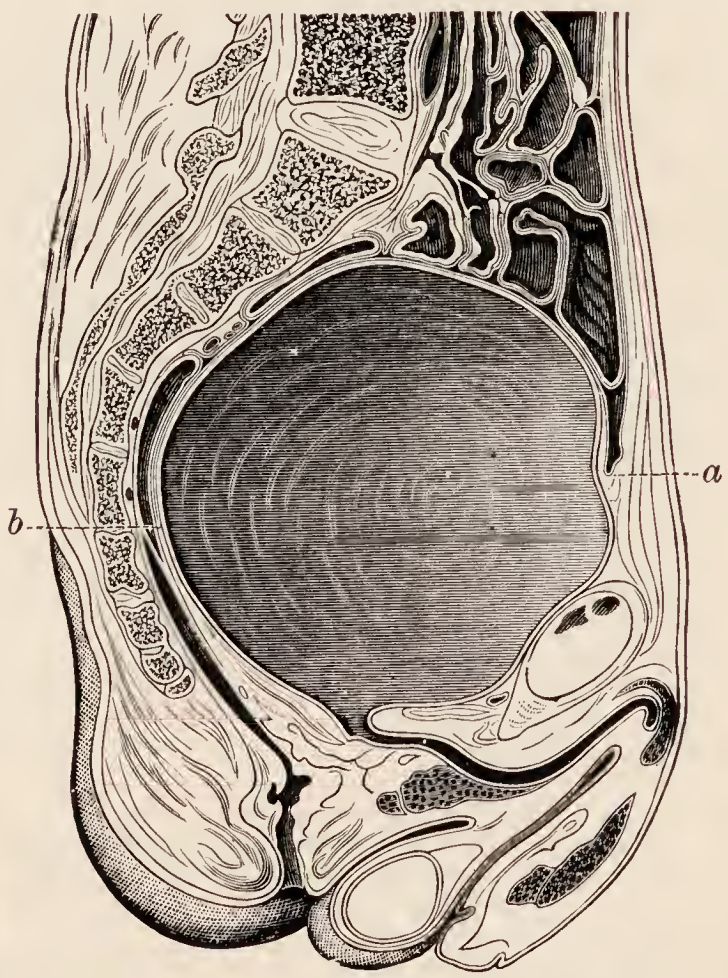



Fig. 1406.—Bladder distended with twenty fluid ounces. *a* and *b*. Folds of peritonæum.

and the pubis, and contains a variable amount of fatty tissue resting on the bladder and continuous with the pelvic and subperitoneal tissues. The bladder here is uncovered with peritonæum, and is not approachable from without in an undistended state, except with great danger of injury to the

fold of peritonæum reflected upon it from the abdomen above. The bladder is known by its pinklike color, oval outline, elasticity on palpation, and the appearance of the outer muscular fibers. If a doubt of its identity then occur the use of the hypodermic syringe will decide the question. The space of Retzius is of great importance, as its extent affords opportunity for wide urinary infiltration and connective-tissue sloughing. And especially is this true if rough and prolonged disturbance of its contents be practiced. If the bladder and rectum be empty the apex of the bladder and the anterior peritoneal fold are below the upper margin of the pubis in all instances. As the apex of the organ is raised above the pubis the peritoneal fold and the contiguous intestines are correspondingly elevated, and the prevesical space is brought into position for safer operative attack (Figs. 1405 and 1406). The base of the bladder is raised upward by rectal distention irrespective of distention of the bladder itself (Fig. 1407). But the apex of the bladder is not elevated by rectal distention unless the bladder also be more or less distended (Fig. 1408). Distention of the bladder alone increases its height in the abdominal cavity and raises the peritoneal fold

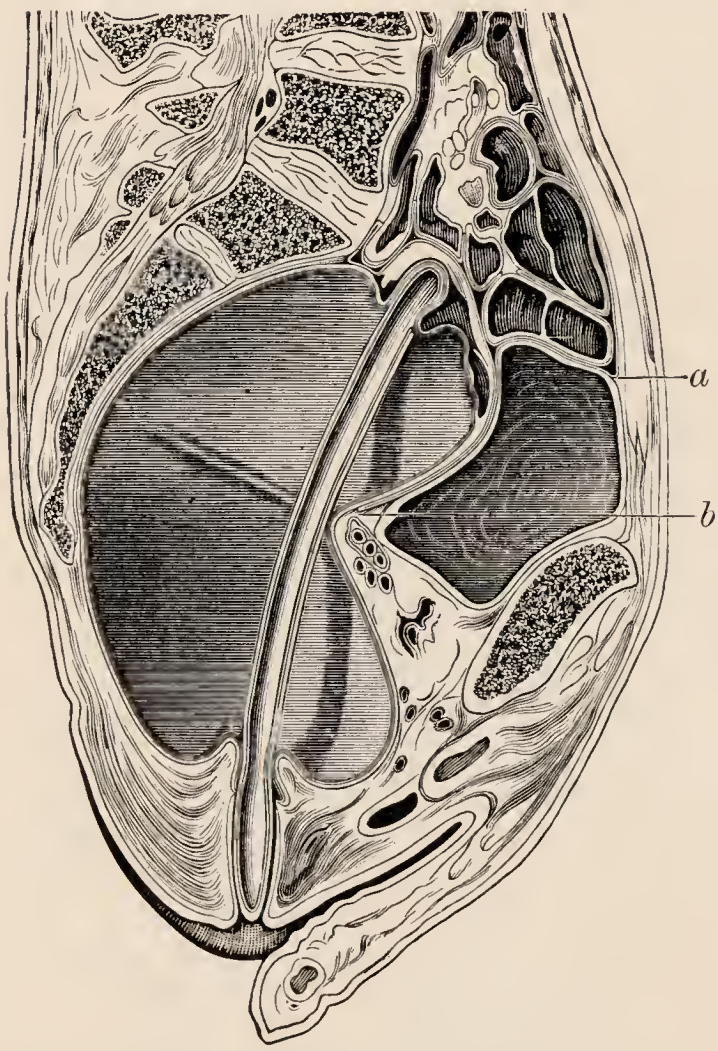



FIG. 1407.—Bladder contains six and a half fluid ounces. Rectum distended with fifteen fluid ounces. *a* and *b* mark the peritoneal folds.

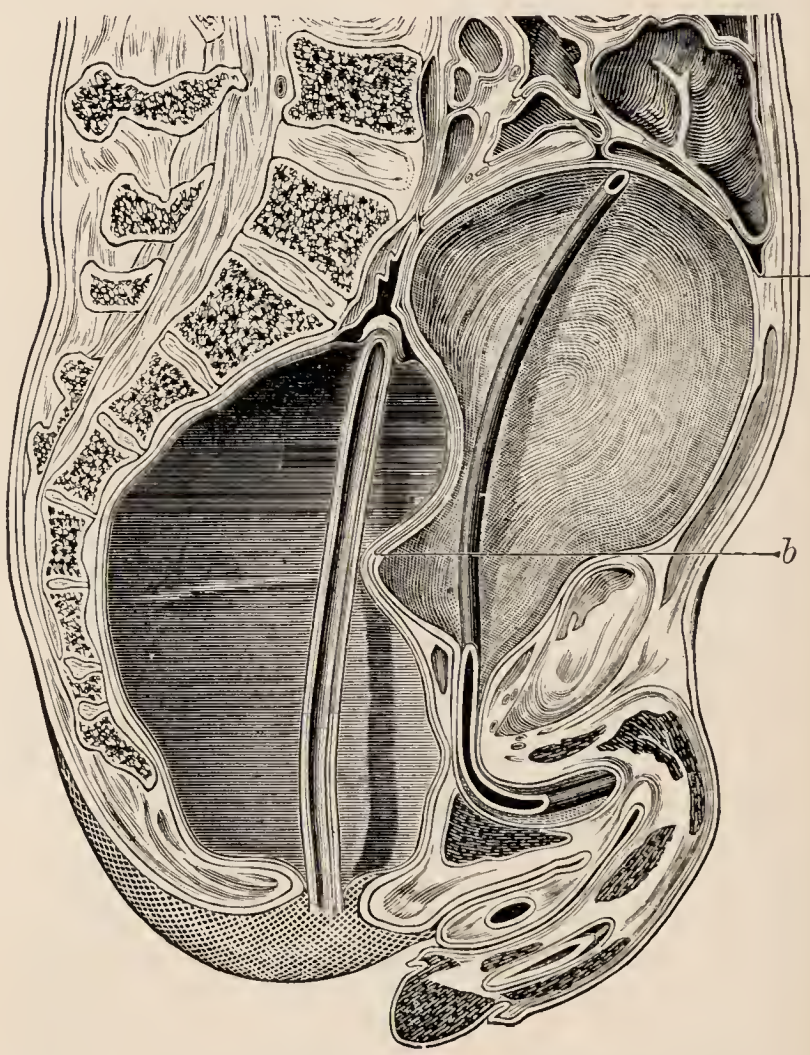



FIG. 1408.—Bladder contains fourteen fluid ounces. Rectum distended with sixteen fluid ounces. *a* and *b*. Folds of peritonæum.

proportionately to the degree of the vesical distention; rectal distention at this time produces a correspondingly similar result. The higher position and the greater mobility of the bladder, in children, permit it to rise, when distended, to a much safer position for operation than in the adult. However, a well-distended normal adult bladder is safely placed for operation if

needed care be exercised. But, when supplemented with rectal distention, all common operative dangers are eliminated (Fig. 1409).

*The Preparation of the Patient.*—The preparation of the patient, so far as the mucous and cutaneous surfaces are concerned, has been indicated already in the operation of cystotomy, lithotomy, etc. In this instance it is essential that the bladder be thoroughly cleansed frequently before, and again at the time of operation, to remove, as far as possible from contact with the wound surfaces the infecting influences that often attend the changes incident to the presence of vesical calculus.

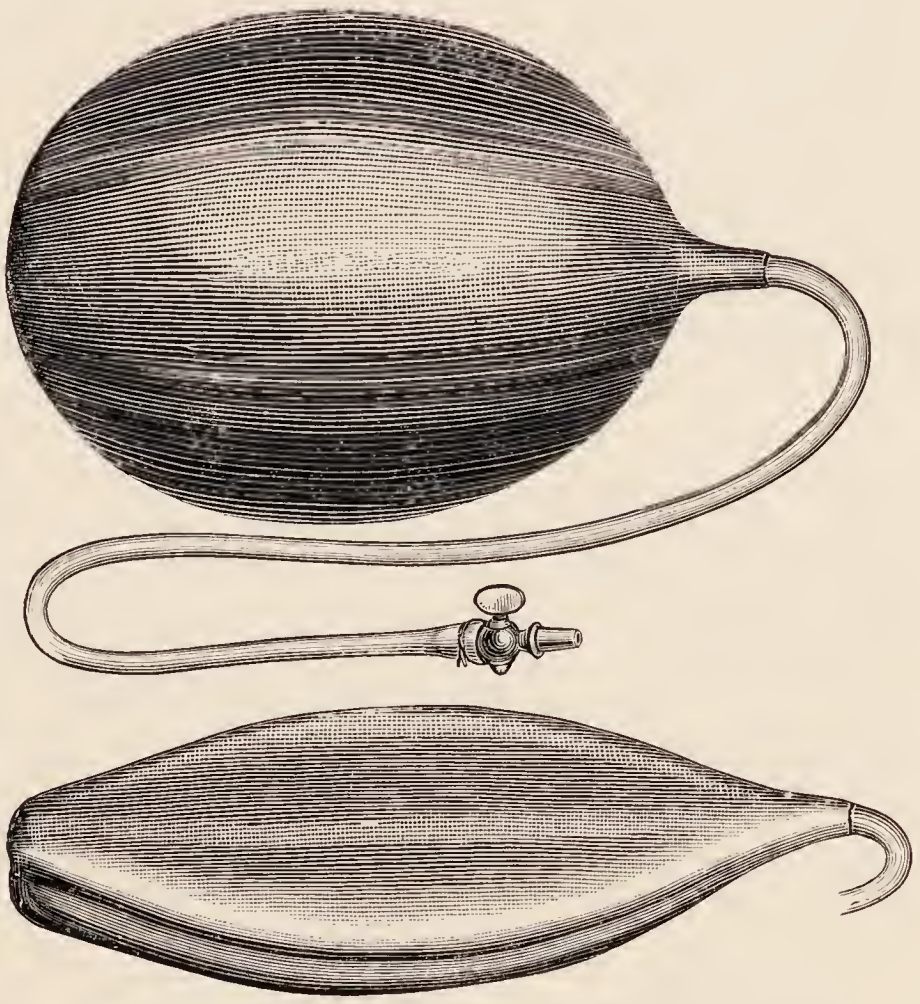


Fig. 1409.—Rubber bag for distention of rectum.

*The Operation.* — Place the patient on the back; induce profound anæsthesia; wash out the bladder with a warm solution of boric acid; leave the catheter in the bladder. Smear with vaseline, fold and introduce the rectal bag well above the sphincters, causing it to lie in the hollow of the sacrum. Introduce into the rectal bag ten or twelve ounces of warm water and clamp the tube. Introduce into the bladder ten or fifteen ounces of a warm solution of boric acid, carefully noting the ascent of the bladder and arresting the flow as soon as the organ is suitably distended. Withdraw the catheter and close the penis with a rubber band, or clamp the catheter and apply the band as before.

The bladder is then exposed and opened in the manner described under "suprapubic cystotomy" (page 415). Extract the stone carefully (Fig. 1410), examine for another, and for the presence of *débris;* remove the constriction from the penis and wash out the bladder through the urethra, if washing be needed. Whether or not the bladder shall be sutured and the abdominal wound closed, is a question that has given rise to much discussion and is not yet settled. In children, and in adults with healthy bladders and limited adipose deposit, immediate union can be safely practiced, provided the prevesical space be drained through a small opening at

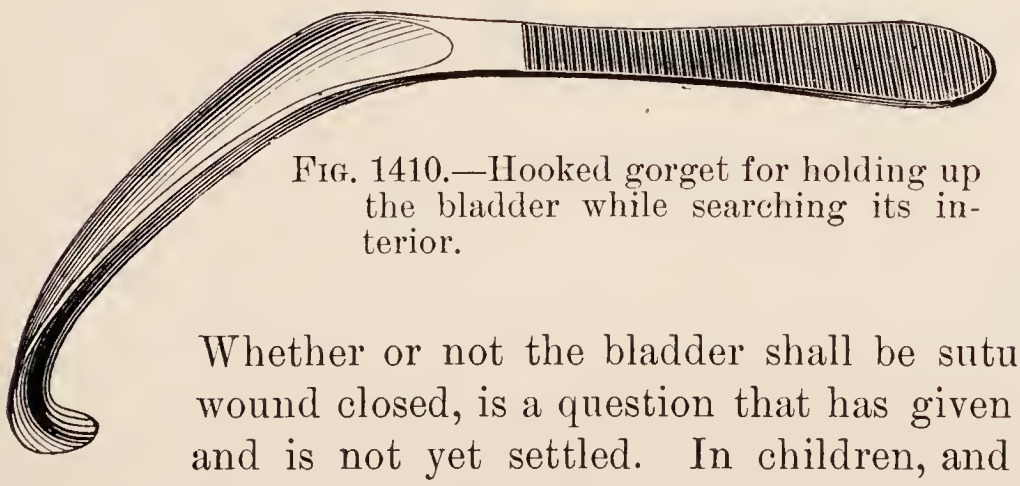


Fig. 1410.—Hooked gorget for holding up the bladder while searching its interior.

the most dependent part of the abdominal wound. And even then frequent, careful, and intelligent scrutiny should be exercised to detect the first manifestation of the escape of urine. In every instance of partial or complete closure, a limited surface at either side of the vesical wound should be freshened and so united with interrupted sutures of silk or chromicized catgut as to secure coaptation of raw surfaces. The Cushing (Fig. 1411), or Halsted (Fig. 850), or double purse-string (Fig. 1412), or the interrupted suture (Fig. 1413) are employed, according to the practice of the operator. The sutures should never pass through the mucous lining of the organ, and a round needle should be used in the sewing. While there are many instances of complete closure recorded by experienced surgeons, both with and without interrupted or continuous drainage through the penis or perinæum for two or three days, followed by perfect results, yet it nevertheless happens that in the majority of instances

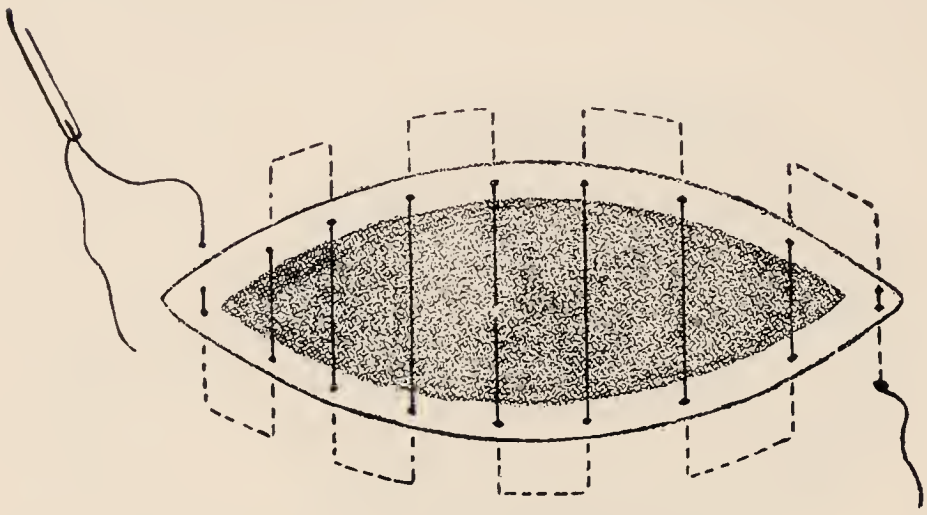


FIG. 1411.—Cushing's suture.

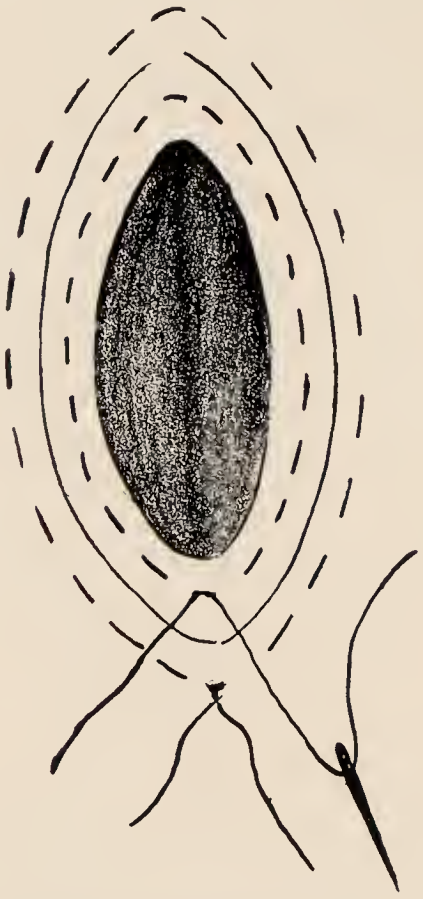


FIG. 1412.—Brenner's double purse-string suture.

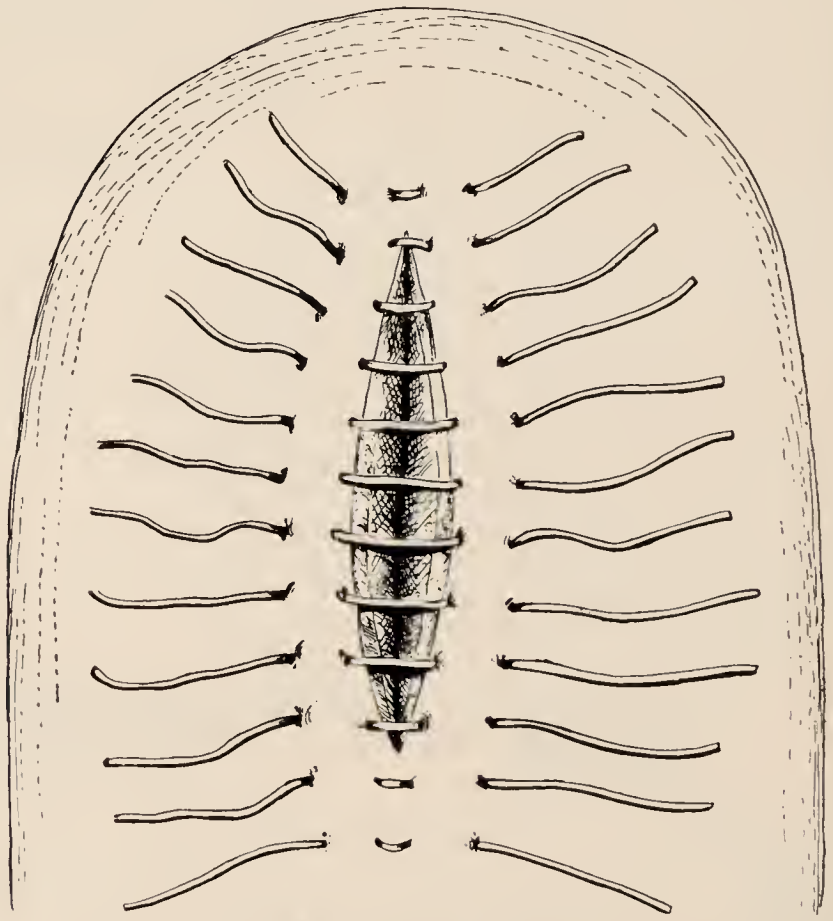


FIG. 1413.—MacCormac's method of placing interrupted sutures.

in which complete primary closure is made, prompt and permanent union does not take place. Therefore, if there be any doubt regarding the proper course to pursue in this respect, the visceral wound should not be entirely closed, and suitable drainage should be established. In case immediate union

be sought for, drainage of the abdominal wound, as already stated, should be practiced, and the bladder relieved with a catheter at regular intervals, if continuous drainage be not employed. *Rydygier* proposed and practiced an intraperitoneal method of operation as follows: He thoroughly cleansed the bladder and the field of operation, inserted and retained in the organ a large catheter, exposed the anterior wall of the bladder in the usual manner—but more extensively opening the peritoneal cavity—drew up and temporarily fixed the bladder to the borders of the abdominal wound by sewing the two tissues together so as to exclude the peritoneal cavity completely from the entrance of urine, opened the bladder, extracted the stone, removed the temporary sutures, and closed the openings in the bladder and abdomen at once, in the usual manner of closing wounds of serous membranes. This method affords abundant space of entrance to the bladder, permits its wall to be drawn upward into, and possibly outside, the wound, and assures one of prompt and firm union because of the apposition of serous surfaces. *Harrington* strongly favors this plan for the reasons already stated.

*The Complications.*—Rupture of the bladder or of the rectum is a complication of great significance, which should be carefully guarded against by attention to the exciting and predisposing influences that occasion it. Septic infiltration of the space of Retzius is a dangerous and often a fatal complication. Free incisions at dependent parts to secure good drainage and the free use of antiseptic solutions are the needed measures of treatment in such cases. Rough handling and infection of the connective tissue of the prevesical space by urinary infiltration or infection are the common causes of this condition. In order to prevent these complications in infected cases, *Senn* advises that the operation be divided into two stages. At first the bladder is exposed and the wound packed with gauze for four or five days, until the spaces are closed by granulation, when the visceral incision is made with cocain anæsthesia in the usual manner. Suppression of urine from kidney disease is often provoked by suprapubic lithotomy, the same as by other operations on the bladder.

*The Precautions.*—If the rectum be diseased the bag should not be employed. If the bladder be greatly diseased, dilatation should be practiced cautiously and perhaps dispensed with entirely, and a perineal operation performed. The introduction of twenty-three ounces of fluid has caused rupture of a healthy adult rectum; the injection of four ounces has caused rupture of a diseased adult bladder. Rupture will rarely happen if not more than eight or ten ounces are introduced into the bladder and rectum respectively. In either instance injection should cease when undue resistance is experienced. Adhesion of the peritonæum to the pubis may prevent the ascent of the bladder. In feeble and relaxed subjects the bladder rises from out of the pelvis freer and further than in those of dissimilar states. It is essential, therefore, to comprehend the possibility of the presence of contraindicating and restraining influences in distending the viscera, or rupture may ensue. If the visceral and abdominal wounds are closed at once, it is wise to test the line of union of the former by moderate distention of the organ with air or fluid before the latter is closed. For, if a defect be

found, it can then be repaired before closure of the abdominal wound, and in the presence of doubtful integrity of the line of union the abdominal wound can be drained.

*The Remarks.*—Whether the bladder or the rectum be distended first is a matter of no special importance in ordinary cases. However, when a fear of the lack of structural integrity of the bladder or of the bowel be present, the impaired viscus should be favored, and the requirement of the healthy one correspondingly increased. Since the distended rectal bag obstructs the circulation of the bladder, thereby congesting its field of operation, the later in the course of the procedure the bag is distended the better it is, in this regard. Still, as the bleeding is not severe and can be promptly checked by ordinary means, by a removal of the bag and opening the bladder, the bleeding is not entitled to special significance, except in rare instances. In children and thin adult subjects, rectal distention need not be employed, especially if the patient be placed in Trendelenburg's position. This posture is especially serviceable in the instances of a pendulous abdomen, and when the light can thus be utilized to the best advantage. The finger is employed to detect the stone before the forceps is introduced, and the opening is then made of the necessary size to admit of the extraction of the stone without injury to the tissues. Some operators distend the bladder with air instead of fluid, claiming that air, being more compressible than fluid, is less liable to cause rupture (Bristow). *Brown* commends the use of air, and advises that the bladder be thoroughly cleansed through a rubber catheter, which is then fastened in place and retained for the purpose of the introduction of air. The apparatus employed in the act is not disconnected at first, but is left temporarily attached, so that on exposure of the fascia additional inflation will cause the organ to approach still nearer to the surface. Finally, the catheter is clamped to prevent the escape of air, and the pump or syringe is removed. Brown commends the bicycle air pump for the purpose, and states that each in-and-out action of the piston is about equal in effect to the introduction of an ounce of water. He likewise recommends that the rectal distention be dispensed with when air is employed in the bladder. Either of the agents, when discreetly employed, meets the indications, and is not a source of especial danger. In the absence of suitable forceps the stone may be removed from the bladder, especially if it be shallow, by means of interlocked fingers (Fig. 1414).

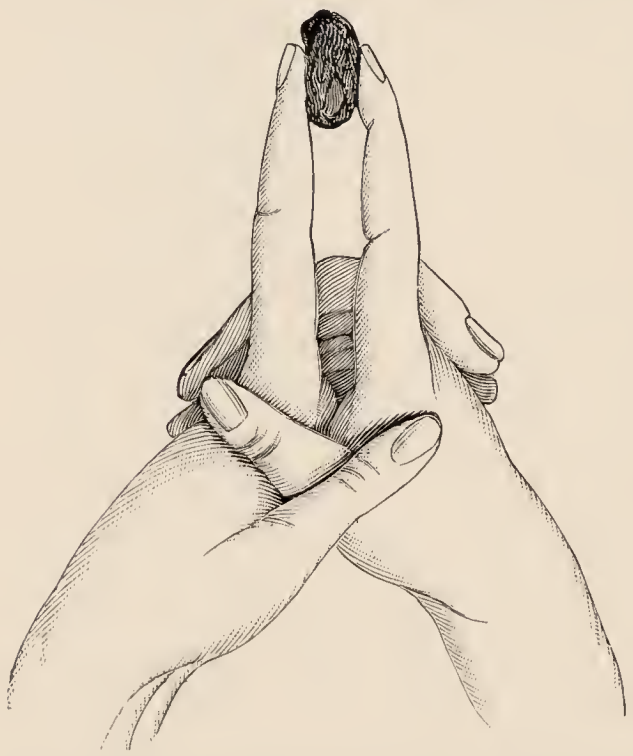


FIG. 1414.—Removal of the stone from shallow bladder by interlocked fingers.

*The After-treatment.*—If the bladder be closed completely, the after-treatment relates to vigilant attention to forestall infiltration, rather than to medical measures. If the bladder be not closed entirely, the bed should be

protected by waterproof sheets and with sponges; the exposed parts of the body thoroughly anointed with vaseline; the wound sprinkled with iodoform; the pelvis well separated from the bedclothes by a large cradle, both for convenience and ventilation. The urine should be absorbed at the wound with numerous sponges and absorbent cotton applied to the part, and changed perhaps two or three times an hour. Of course, the siphon drainage, already described (page 1126 *et seq.*), should be employed, and, when efficient, will relieve the patient and the attendants of much trouble. However, any form of drainage is often fickle, on account of the uncertainty of action contingent on the manner of adjustment and the co-operation of the patient. The wound and the bladder should be thoroughly cleansed when needed, and the patient caused to sit up as soon as practicable. The wound in the bladder usually closes in from two to four weeks. Bandaging and strapping interfere with drainage and do not hasten repair.

*The Results.*—The death rate is about 13 per cent in practice at large, but is much less in the hands of those skilled in the selection and employment of the method.

*The Choice of Operation.*—The choice of operation in the various cases of stone in the bladder is not always easy to determine. In a general way the determining reasons of choice are indicated already in connection with the respective operations. It seems proper to add in this connection the statistics of White, relating to the influence of age on the outcome of operative methods.

*Infancy to Puberty.*—Perineal lithotomy, 602 cases; suprapubic lithotomy, 637 cases; litholapaxy, 284 cases, with a death rate of 3.1, 13.1, and 1.7 per cent respectively.

*Puberty to Middle Age.*—Perineal lithotomy, 226 cases; suprapubic lithotomy, 159 cases; litholapaxy, 485 cases, with a death rate of 9.7, 11.3, and 4.5 per cent respectively.

*Old Age.*—Perineal lithotomy, 69 cases; suprapubic lithotomy, 91 cases; litholapaxy, 581 cases, with a respective death rate of 19, 18, and 7 per cent.

*Cunningham*, according to his own experience (133 cases), regards litholapaxy as suitable for all but 3 per cent of the cases.

Irrespective of the aforegoing results it should not be overlooked that one is likely to succeed best—other things being equal—in the use of the method of practice with which he is the most familiar.

**Foreign Bodies in the Urethra.**—It is rare indeed that stones form in the urethra. Usually they are arrested there during the passage of the urine. The prostatic sinus, the membranous urethra just behind the anterior layer of the triangular ligament (Fig. 1378, *d*), and the navicular fossa, are the common sites of lodgment. Sometimes they are arrested at the peno-scrotal junction. A marked narrowing at any part of the urethra may arrest their passage. Complete and incomplete obstruction may be caused, depending on the diameter of the stone or that of the canal. The degree of the obstruction is indicated practically by the arrest and the freedom of the flow of the urine through the urethra.

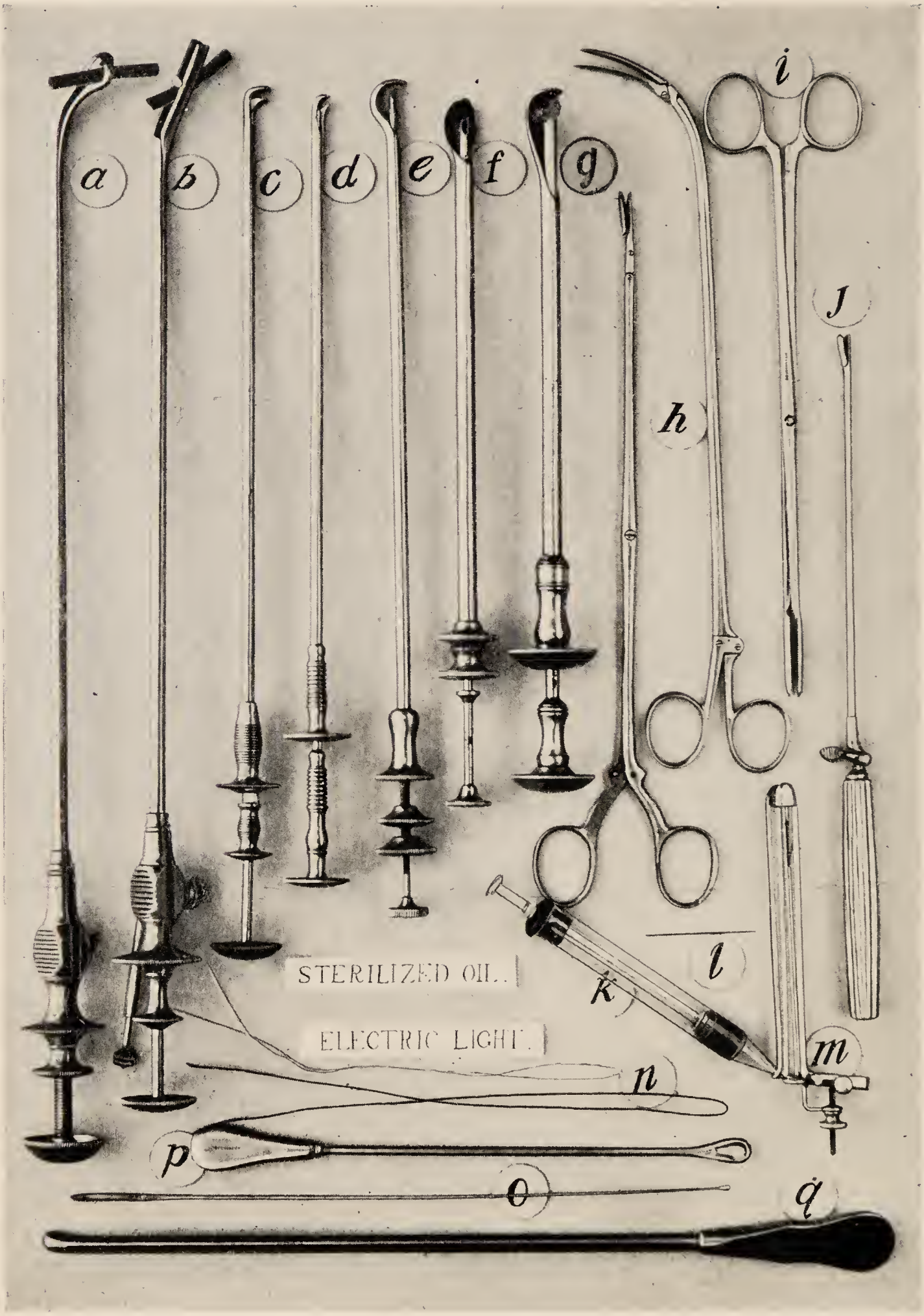



FIG. 1415.—Instruments employed in removal of foreign bodies from urethra and bladder.

*a*. Mercier's duplicator for use in the bladder. *b*. Collin's broken catheter extractor. *c*. Galante's crusher. *d*. Nélaton's urethral crusher. *e*. Reliquet's urethral crusher. *f*. Mathieu's lithotrite. *g*. Old pattern of urethral lithotrite with calculus in jaws. *h*. Mathieu's curved urethral forceps. *i*. Thompson's urethral forceps. *j*. Short-jawed urethral forceps. *k*. Syringe. *l*. Needle for "needling" stone in urethra. *m*. Urethral spatula *n*. Loop of wire and of silkworm gut to lasso urethral calculi. *o*. Silver probe. *p*. Urethral scoop. *q*. Wheelhouse's staff for perineal section.

*The Treatment.*—In partial obstruction, the sudden arrest of the flow of urine and the distention of the urethra attendant on grasping the head of the penis during micturition will cause dislodgment and escape of the stone. Distention of the canal in front by an oleaginous injection, or the introduction and sudden removal of a large blunt sound during urinary effort, may meet the demand. If situated far in front, the stone may be worked out by manipulation with the fingers, aided by urinary pressure. If soft, it may be crushed with the fingers and washed out by the urine. If located behind the compressor urethræ, it may be pushed back into the bladder during a urinary effort and crushed later. A urethral scoop may be insinuated behind it while it is steadied with the fingers, or a small urethral stone crusher may be used in a similar manner, when the obstruction may be removed intact or crushed and removed (Fig. 1415). It may be caught and removed by means of the straight or curved alligator forceps (Fig. 1415). Failing in these expedients, it can be readily removed through a small free incision into the urethra at the site of lodgment. It is better that the stone be removed through a free incision than to cause laceration of the urethra in the efforts of removal by other methods (Figs. 1416 and 1417). An incised wound of the urethra usually heals promptly. It may be feasible to needle it, as is sometimes practiced for gallstone obstruction (page 814). Sharp-pointed objects, like pins, needles, etc., can be removed as indicated in the illustrations (Figs. 1418, 1419, and 1420).

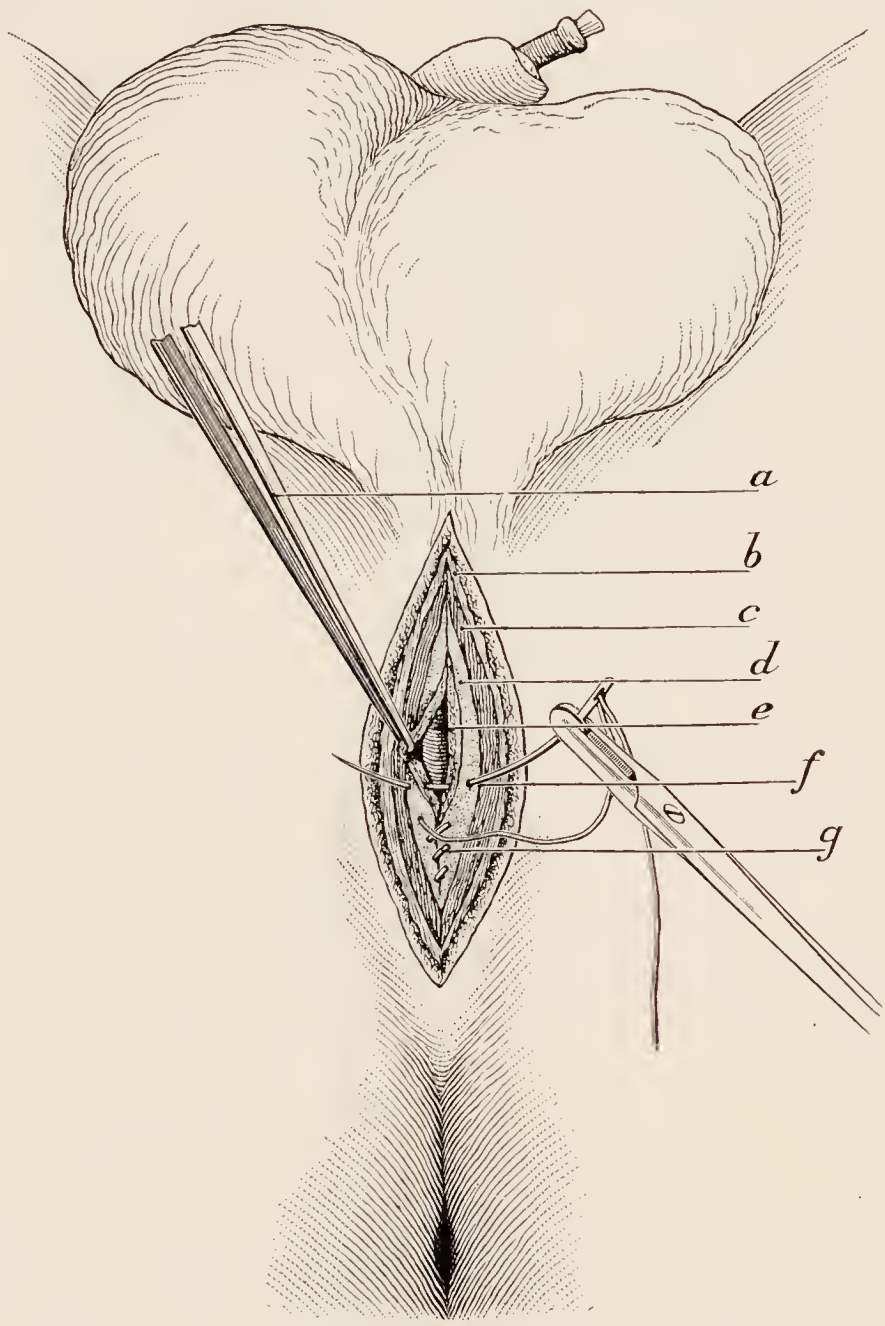



FIG. 1416.—Suture of urethra after incision for removal of stone, etc. *a*. Forceps. *b*. Superficial perineal fascia. *c*. Accelerator urinæ muscle. *d*. Urethra. *e*. Sound or catheter for support of urethral walls during sewing. *f*. Depth to which stitches are carried. *g*. Sewed surface of urethra.

**Foreign Bodies in the Bladder.**—An unlimited variety of foreign bodies gain access to the bladder because of violence, defective instruments, the mishaps attending operative practice, and those incident to the acts of sexual perversion, etc. The nature, shape, and size of a foreign body, and the re-

centness of the entrance are all matters of special significance bearing on the question of promptness and method of treatment. The things not suited to enter and traverse the urethra should be taken away by the perineal or suprapubic routes. Small and freely movable objects may be removed by the evacuator (Fig. 1360 *et seq.*) or lithotrite. Long, flexible, and suitably bent objects can be removed by instruments designed for the purpose (Fig. 1415). All objects are easier and safer removed early in the history of the case, before incrustation or cystitis attend their presence. It is proper to note at this time that long objects usually lie transversely in the bladder, and when the organ is empty an object longer than four inches is thus placed, while one five or more takes a vertical or oblique position. The employment of the cystoscope, to determine the characteristics of the body, its location and direction should not be overlooked. If incrustation have already taken place, the gentle use of the lithotrite may be sufficient to dislodge it, especially if deposited on a flexible substance.

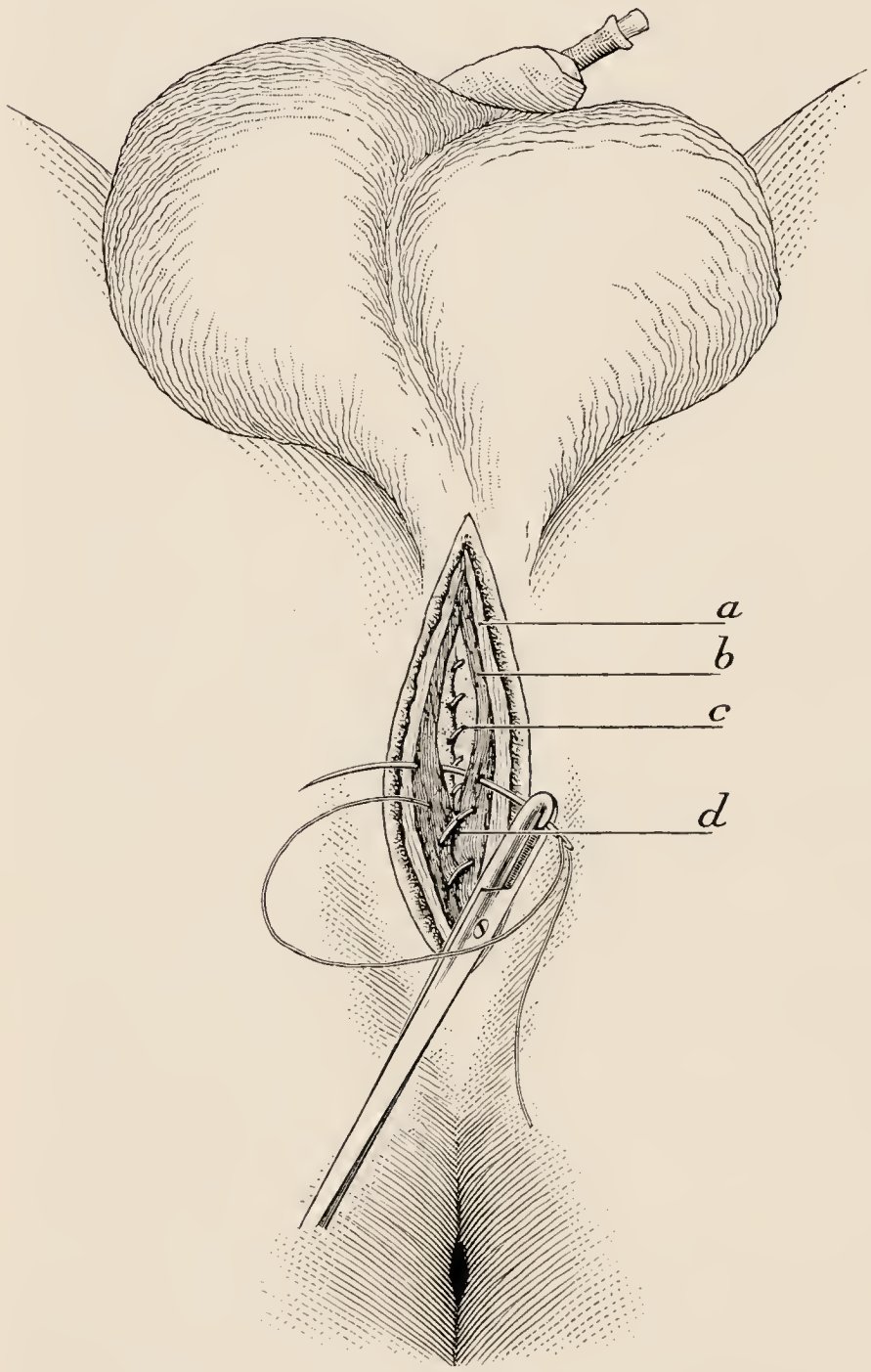



Fig. 1417.—Suture of deep tissue over line of urethral sewing. *a*. Superficial perineal fascia. *b*. Accelerator urinæ muscle. *c*. Line of sewing of urethra. *d*. Sewing muscular flaps over urethral incision.

Catheters may be removed by withdrawal in the long axis (Fig. 1415), or by doubling, if the caliber of the urethra will permit. Much patience and skill are needed to locate and so change the direction of rigid bodies by means of instruments having, or devoid of, special mechanism to secure their harmless delivery. The presence of cystitis or of kidney disease admonish that care be practiced in every manner.

**Lithotomy, etc., in the Female.**—Aside from lithotrity and litholapaxy, a stone may be removed from the female bladder by dilatation of the urethra, and by vaginal and suprapubic lithotomy.

*Dilatation of the Urethra.*—Dilatation of the urethra is applicable to the removal of small stones. A stone an inch in diameter can be removed thus without much danger of troublesome incontinence of urine; when

larger than this, another method should be practiced. The dilatation can be accomplished by large sounds, graded uterine stems, followed in turn by the fingers. Instruments specially designed for the purpose are often employed. After suitable dilatation is secured, the stone is removed with slender forceps.

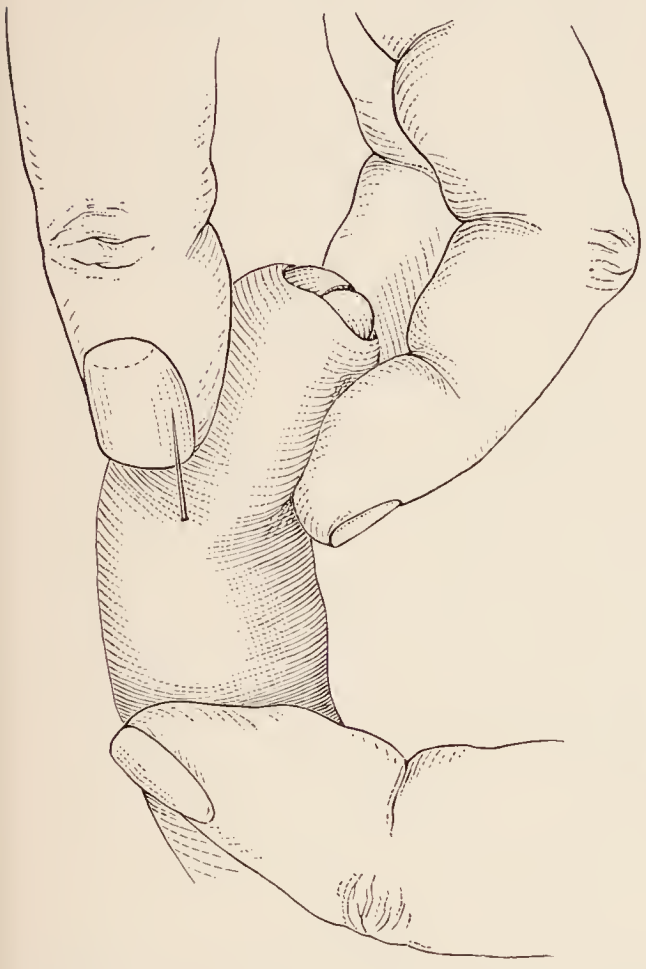


Fig. 1418.—The removal of a pin from the urethra, first step. Causing pin to puncture tissues.

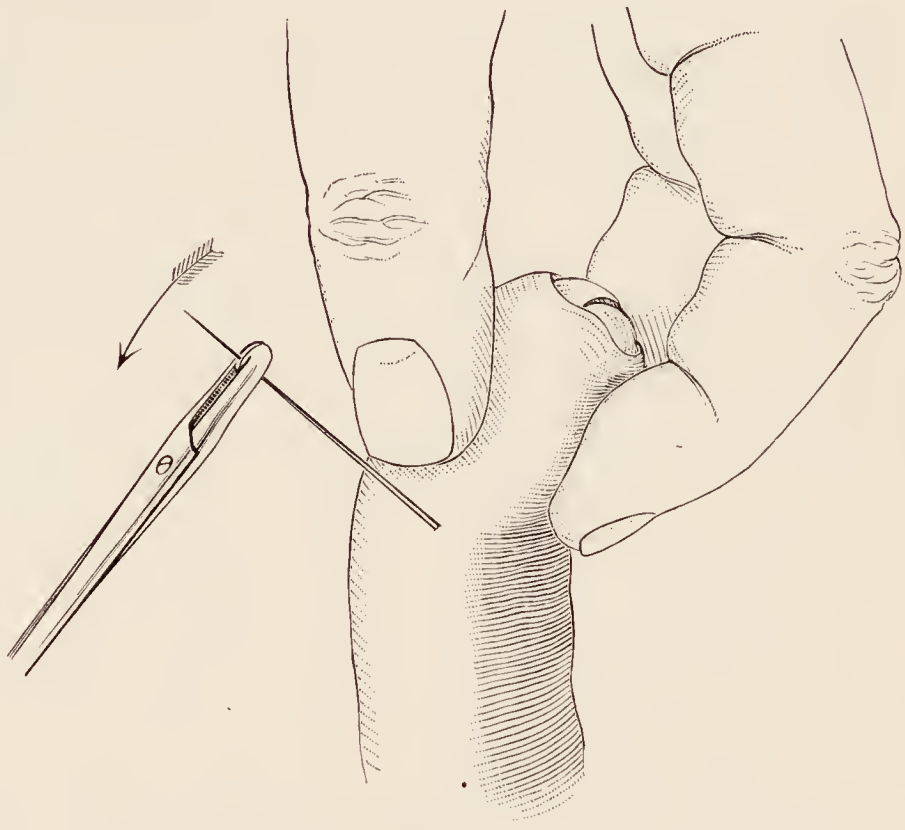


Fig. 1419.—The removal of a pin from the urethra, second step. Turning pin.

*The Precautions.*—Overdistention of the passage may cause rupture of the urethral structure and lead to incontinence. If the stone plus the thickness of the forceps be too large, the stone should be crushed and the fragments removed as in the male.

*The vaginal method* consists in connecting the vagina with the cavity of the bladder by a longitudinal incision made in the median line of the vagina, the length varying according to the size of the stone. The patient is placed on the back and a grooved staff is introduced into the bladder; the position of the groove is ascertained by the finger, and the tissues between the finger and the groove are divided by a scalpel or scissors. The stone is grasped and removed by forceps; if too large, it should be crushed and removed piecemeal.

The wound in the bladder should be closed at once if practicable; if not, it may be left to heal spontaneously—which it often promptly does—or can be closed

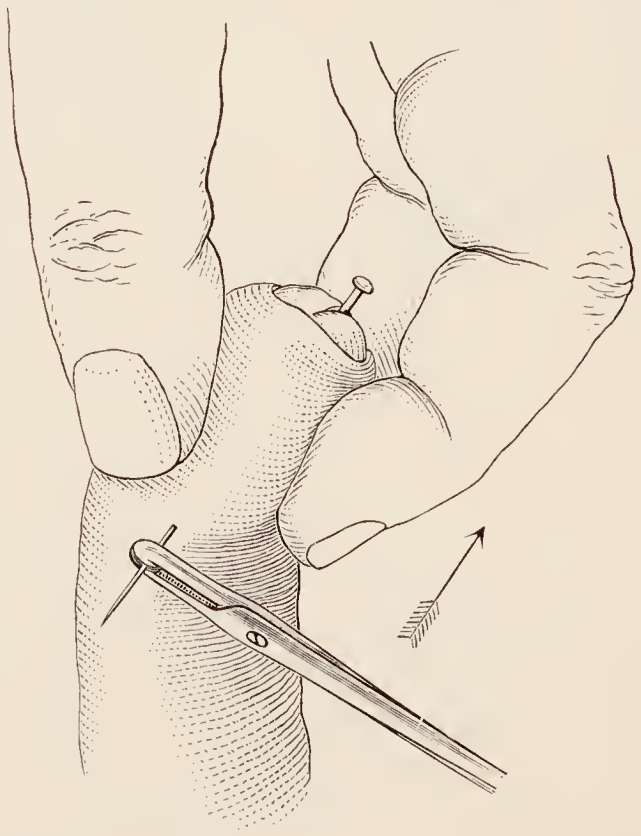


Fig. 1420.—The removal of a pin from the urethra, third step. Passing head out of meatus.

thereafter by an independent operation. The tendency to the formation of phosphatic deposits during the healing process is controlled by frequent irrigation with tepid water only, or by tepid water acidulated with nitric or hydrochloric acid. A solution of the acetate of lead—one grain to the ounce of warm water—is highly extolled for this purpose.

*Suprapubic Lithotomy in the Female.*—If the stone be too large for removal by the vagina and too hard for crushing, the suprapubic method is then advisable. The technique of this method in the female is similar to that in the male.

## CHAPTER XVIII.

### *OPERATIONS ON THE SCROTUM AND PENIS.*

**Hydrocele of the Tunica Vaginalis Testis.**—The operative measures for the treatment of this affection are the palliative and radical measures.

*The Anatomical Points.*—The testicle is variously situated to hydrocele, usually behind (Fig. 1421), sometimes below (Figs. 1422 to 1425), and rarely indeed in front of it. The superficial tissues of the scrotum may cover loosely the fluid collection or be drawn smoothly around it, depending on the degree of the distention. The scrotal vessels can commonly be seen coursing through the tissues near to the surface. Not infrequently a hernial protrusion trespasses on the region. The position of the testicle and the presence of hernia ought always to be determined before the operation is begun. Transmitted light will indicate the relation of the fluid to the testicle and often determine the presence of intestine. However, the history of the case and the influence on the position of the intestine of dorsal decubitus are the better determinative means of the latter conditions.

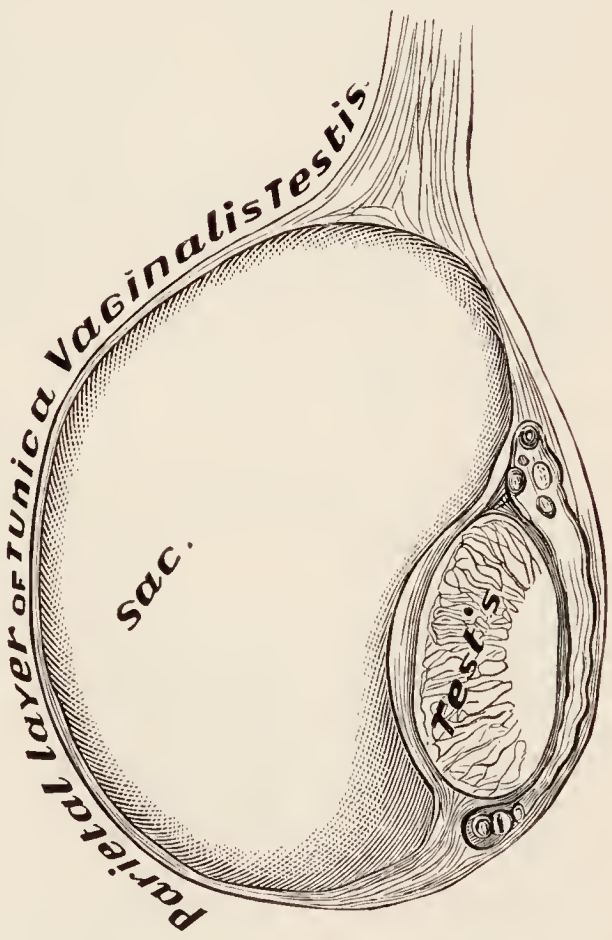


FIG. 1421.—Usual form of hydrocele.

*In a binocular hydrocele* (Fig. 1426) a constricted part of the vaginal process lying in the inguinal canal separates a hydrocele of the tunica vaginalis from a distended vaginal process above, shut off from the peritoneal cavity. From change in posture or alternating pressure above and below a variation in the sizes of the respective enlargements can be seen.

**The Palliative Treatment.**—The palliative treatment relates to the evacuation of the fluid from time to time, as recurring distention demands, by tapping. Comfort rather than cure is sought for, as this measure rarely indeed cures the affection, unless acute inflammation supervenes. Strict asepsis should be practiced in tapping, to obviate unbidden inflammatory sequels.

*Tapping.*—Tapping is a simple process, requiring a small trocar and cannula, or an aspirating needle, or an instrument of a similar nature. The

patient is caused to sit upright on the edge of a chair with the limbs separated, or to lie on a lounge, and the enlargement is seized by the left hand and the tissues made tense over its anterior surface. The testicle is carefully located, and the course of the scrotal vessels as cautiously avoided. The instrument, guarded by the end of the finger to limit the extent of the puncture (Fig. 1427), is quickly plunged upward and backward into the scrotum at about the junction of its middle and lower thirds. As the fluid escapes, the end of the cannula is turned away from the testicle, and the tumor is compressed carefully to expel the entire fluid collection. After the fluid is removed and the puncture is closed, the scrotum is suspended and the patient kept quiet, otherwise inflammation of the sac may occur, which, while it may lead to a radical cure, will not be welcome, as it causes much pain and confines the patient unexpectedly to bed.

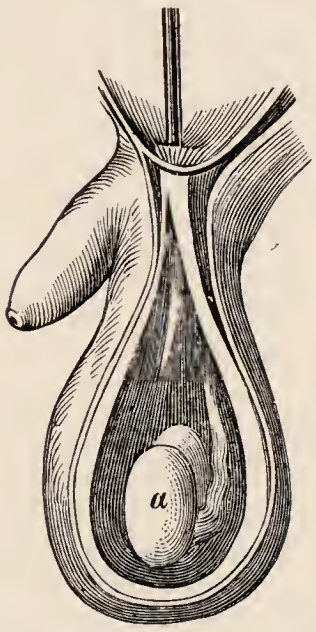



FIG. 1422.—Hydrocele of the cord communicating with the tunica vaginalis testis.

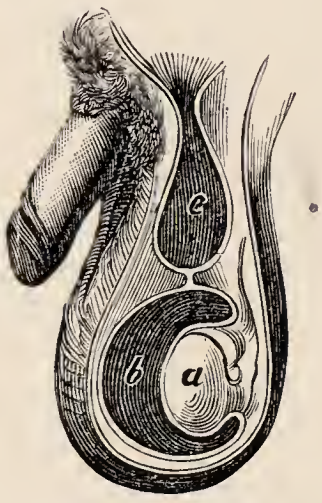



FIG. 1423.—Hydrocele of the cord communicating with the peritoneal cavity.

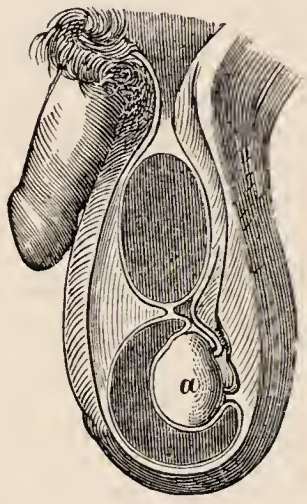



FIG. 1424.—Encysted hydrocele of the cord.

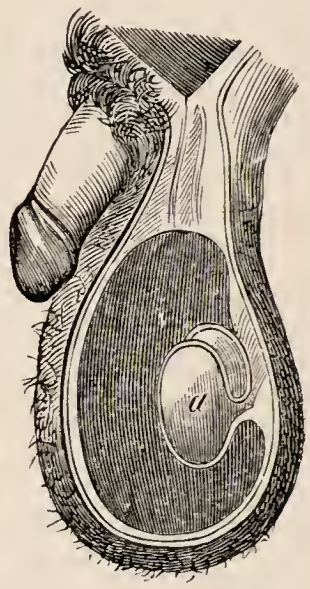



FIG. 1425.—Hydrocele of the tunica vaginalis testis.

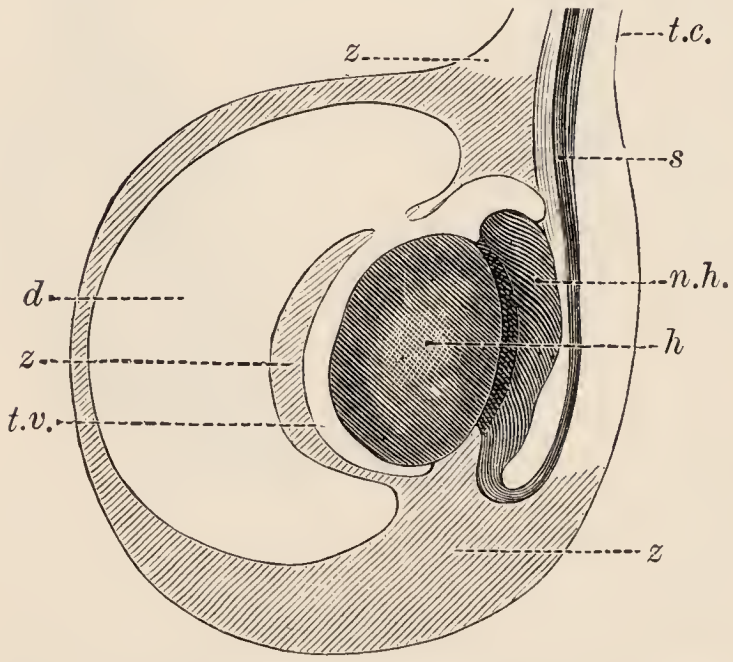



FIG. 1426.—Bilocular hydrocele. *t. c.* Parietal layer of tunica. *s.* Spermatic cord. *n. h.* Epididymis. *h.* Testis. *d.* Cavity of diverticulum. *t. v.* Cavity of the tunica vaginalis proprius. *z, z.* Inflammatory new formation between the visceral and parietal layers.

*The Precautions.*—The testicle, the epididymis, or a herniated gut may be punctured by the trocar, unless the exact location of the fluid has been determined by transmitted light. A blunt trocar, or an ill-fitting cannula, or a halting thrust may push a thickened tunica vaginalis in front of the instrument. The puncture of a vein of scrotal tissue will cause extravasation and extensive ecchymosis of the scrotal structure. An infected trocar may cause extensive inflammation and sloughing of the scrotal tissue.

*The Results.*—A repetition of the operation will probably be required in four or six months, and perhaps sooner. The redundant scrotum due to overdistention will soon approximate the normal dimensions.

**The Radical Measures of Treatment.**—The radical measures of treatment are injection, incision, and excision of more or less of the parietal layer of the sac.

**The Treatment by Injection.**—The treatment by injection usually begins after the evacuation of the sac by tapping. The fluids recommended for the purpose are quite numerous, among which the preparations of iodine and of carbolic acid (Levis)—especially the latter—are preferred. However, rectified spirit, port wine, solutions of the sulphate and chloride of zinc, and chloride of mercury, are each occasionally employed. The special apparatus required in the performance of the operation is the rubber injection bag, in addition to the ordinary trocar (Fig. 1428). After thorough aseptic preparation of the parts and with the patient sitting or lying, the trocar is introduced and the fluid drawn off as in tapping. The scrotum is then seized and held steadily, to prevent the escape of the extremity of the trocar from the cavity of the sac, and the medicated fluid is thrown in by means of the gum bag. If the compound tincture of iodine be used, it may be diluted with three or four parts of water. The introduction of three or four ounces of the mixture is quite sufficient. It should be brought in contact with the apposed surfaces of the sac by manipulation and retained for five or ten minutes, or until the patient complains of pain or faintness, and then allowed to escape through the cannula. If the pure tincture be used, a drachm or two injected in the same manner, and allowed to remain, is quite sufficient. If the sac be small, fifteen or twenty drops may be thrown into it by a hypodermic syringe, without the previous removal of the fluid, and its diffusion secured by manipulation.

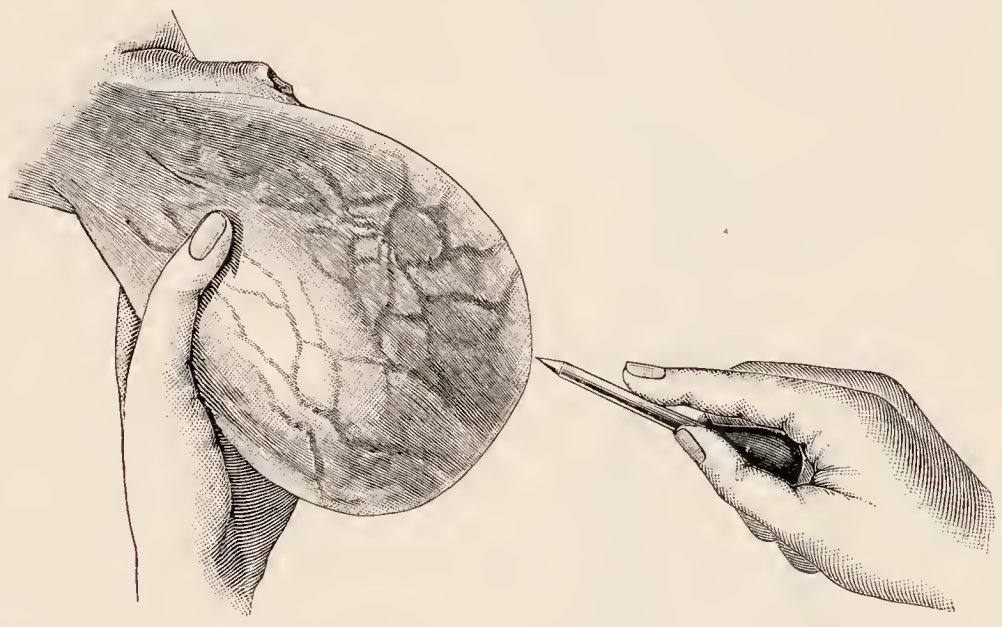


FIG. 1427.—The tapping of a hydrocele of tunica vaginalis. Showing finger resting on instrument and tumor compressed by hand.

A drachm or two of a ten- to fifty-per-cent solution of carbolic-acid crystals in glycerin may be injected and allowed to remain. From half a drachm to a drachm of pure carbolic is often injected into the empty sac, or while yet there remains a small amount of the fluid undrawn. Carbolic acid causes less pain and is a more constant and certain remedy than iodine. This plan of practice is strongly advocated by competent observers, and frequently after the injection the patient is permitted to be out and around.

*The Precautions.*—Inasmuch as the pain attending the injection is often severe, and as fainting may occur, the recumbent posture is advisable. The injection of a congenital hydrocele is manifestly a dangerous expedient, but the diagnosis of its presence will prevent accident. The unsuspected escape of the end of the cannula from the sac, and the consequent introduction of the injection of the scrotal tissues, is an unfortunate occurrence, especially when followed by extensive inflammation and sloughing. If the end of the cannula thus escapes, an independent puncture should be made at once, as the previous opening can not be easily found. Injection for the cure of a hydrocele dependent on malignant disease of the testicle is useless and misapplied treatment, to say the least. Hydroceles with thick walls are not suited for cure by injection.

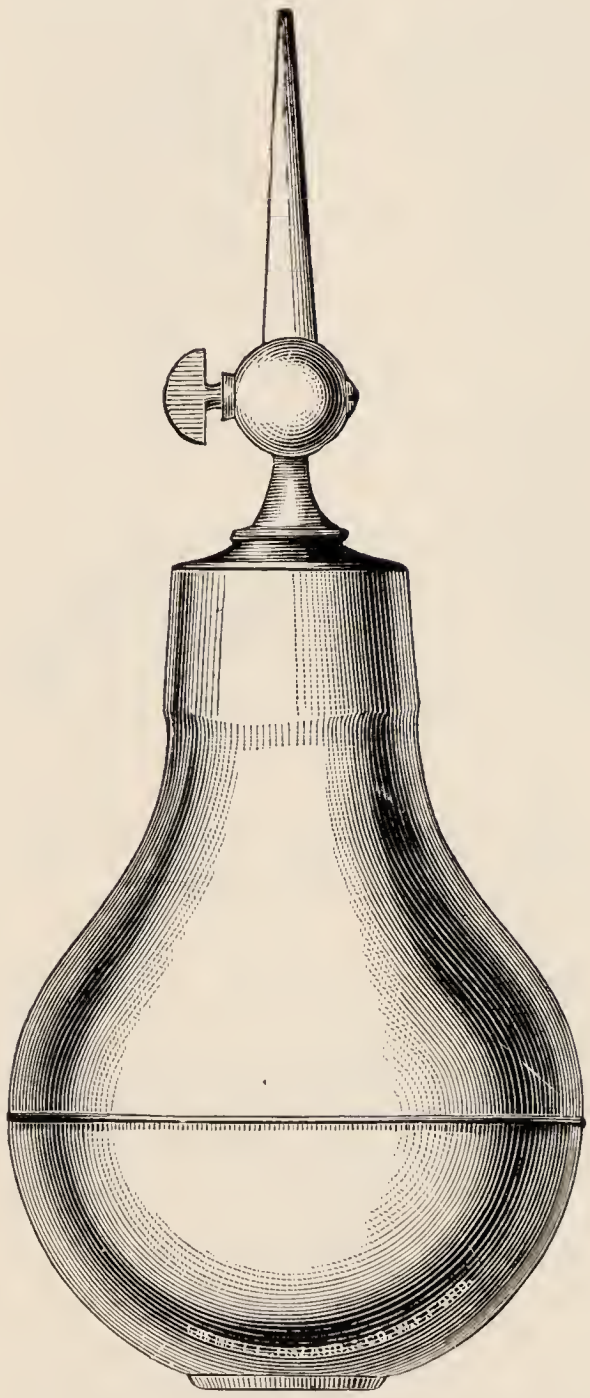


Fig. 1428.—Rubber bag for injecting.

*The after-treatment* in these cases consists in putting the patient to bed, suspending the scrotum and keeping evaporating lotions applied to it, and giving anodynes to allay pain. The patient should remain in bed until the acute symptoms subside, after which he is allowed to go around with the scrotum suspended. A month or so is requisite for the restoration of the parts to the normal state. Insignificant inflammatory reaction portends a failure of the attempt at cure.

*The Results.*—The use of iodine as commonly employed fails of cure in nearly 18 per cent of the cases. The percentage of failure from carbolic-acid treatment is less (13 per cent), and a second injection rarely fails to cure. By this method of practice discomfort and confinement are reduced to a minimum. Rare instances of extension, local inflammation, of sloughing, of carbolic-acid poisoning, and of death, are reported as dependent on the carbolic-acid treatment.

**The Treatment by Incision** (Volkmann).—After thoroughly shaving and cleansing the parts and wrapping the penis in gauze, the sac is laid open for two inches at the anterior and lower aspect of the tumor, and the borders of the tunica vaginalis are stitched to the edges of the skin incision by six or seven chromicized catgut ligatures introduced at either side (Fig. 1429). A large drainage tube is introduced into the cavity of the tunic, the wound dusted lightly with iodoform, and dressed with iodoform gauze. The patient is kept in bed for ten or twelve days, and the wound kept clean by repeated washing and dressing with an aseptic solution. The tube is

shortened from day to day and removed entirely at the end of the first week. The catgut sutures are removed during the first week, and by the end of the third the patient is permitted to resume his usual mode of life with the scrotum suspended. The suspensory should be worn for three or four months after the operation.

*The Remarks.*—This operation permits of the examination of the testicle and determination if it be diseased. Sometimes an insignificant grade of inflammation of the testicle attends the healing of the wound. Insufficient drainage may be followed by extensive suppuration, and even sloughing of the tissues, especially in debilitated subjects. Light packing of the cavity with iodoform gauze may be used in place of the drainage tube. *Treves* practices a free swabbing out of the cavity of the tunica vaginalis with pure liquefied carbolic acid, followed by free drainage and frequent irrigation.

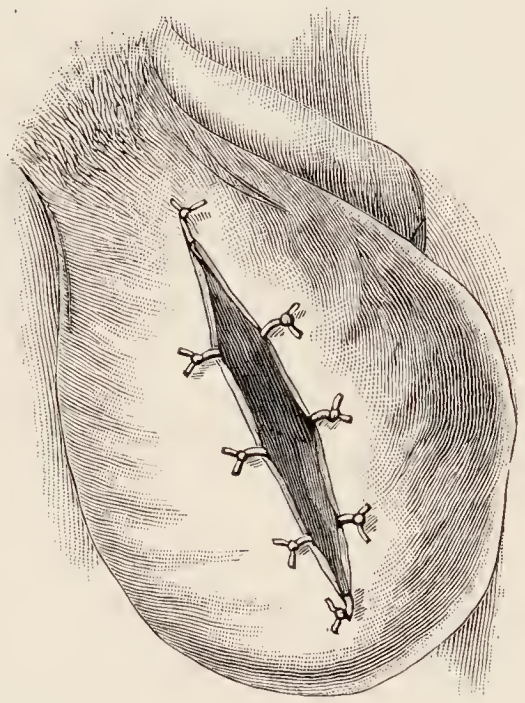


FIG. 1429.—Treatment of hydrocele by incision, Volkmann's method.

**The Treatment by Excision of Parietal Layer of Sac** (Von Bergmann).—Either complete or partial excision of the sac may be practiced. In complete excision prepare the patient for this operation the same as for the preceding methods. Make an incision three inches long at the anterior and outer aspect of the hydrocele into the sac; remove the parietal part of the sac from the structures of the cord and scrotum down to the testicle, if practicable, by blunt dissection, and cut it away with scissors. Introduce a large drainage tube, close the external wound around it with sutures, and dress the part with iodoform gauze. The patient is confined to bed usually for a week or ten days.

**The Treatment by Partial Excision.**—In partial excision a portion of the sac is cut away for a short distance at either side of the primary incision. As a modification it allows a freer escape of the discharges, and prevents the protrusion of the rigid tunic, but otherwise it makes no practical difference with the outcome. The external incision in this method is made longer than in the former, affording, therefore, more suitable drainage.

The wound, after this operation, is treated in a similar manner as in the preceding method.

*A still further modification of the technique* presents, in our opinion, the best operative procedure for the radical cure of hydrocele. A long incision is made into the tunica vaginalis, and the condition of the testis ascertained. The rigid protruding borders of the divided tunic are then excised in the direction of the long axis of the external incision about halfway back to the testicle, and the borders of the remaining portions stitched by fine catgut to the subcutaneous scrotal tissues corresponding to them. The cavity is freely irrigated with a strong solution of bichloride of mercury or carbolic acid, a drainage tube is introduced, the scrotal wound closed around it, and

the flaps quilted together back to the line of division of the tunica vaginalis by catgut sutures, to prevent the contractions of the dartos from disturbing the union and to limiting the area of the wound. The whole is then dusted with iodoform and surrounded by antiseptic gauze.

The wound usually heals completely under the primary dressing without an unfavorable manifestation.

*The General Remarks.*—Only a total obliteration of the sac affords a positive assurance of complete and final cure. A partial obliteration predisposes to a return. Permanent cures take place without any obliteration of the sac, as is illustrated by the rare instances of cure that follow simple tapping. The presence of limited hydrocele at any part of the sac or cord can be treated safely and successfully by the preceding means, provided vigilant diagnostic discrimination and proper surgical technique be exercised.

*The Results.*—Aseptic incision, with packing of the sac, or flushing or swabbing the cavity with an irritant, is productive of better results and with no more danger than is injection. The patients, however, recover more slowly and are confined longer in bed.

*The Choice of Operation.*—Radical cure by irritant injections should not be practiced in instances in which the hydrocele may be dependent on local or general disease, or be complicated with an illy defined or congenital hernia, or severe pain and extreme old age. The presence of multiple cysts, or a huge one, and repeated failures by this method or the fear of poisoning (carbolic), forbid its employment. Therefore, treatment by palliative tapping or some form of radical incision should be employed in these classes of cases. If the hydrocele be congenital, an incision similar to that for the radical cure of hernia may be required for cure.

**Castration.**—Castration is ordinarily a simple operation, and practically devoid of danger to the patient except in special cases.

After the pubes, scrotum, and perinæum are shaved and thoroughly cleansed with soap and antiseptic solutions and the penis incased in gauze, place the patient on the back, introduce a large sponge below the testicles between the thighs to collect the fluids, and administer the anæsthetic.

*The Operation.*—Seize the testicle with the left hand and draw the scrotal tissues equally and tightly over it; make an incision from just below the external abdominal ring downward to the lower limit of the scrotum through the tissues down to the cord and tunica vaginalis, arresting hæmorrhage as it occurs. The testicle can now be removed along with the uncut tunic and with the cord by enucleation with the fingers or a dull instrument. In doubtful cases it is better to open the sac in order to scrutinize the testicle and judge if it be necessary after all that it be removed. Although an additional risk of infection is thus incurred, the possible gain to the patient and the readiness with which it may be enucleated, the same as before, wisely sanctions the step. If the testicle and the visceral layer of the tunic only are to be removed, the parietal part of the tunic is severed around the testicle as closely to it as possible with scissors. In the event of the removal of the organ, the cord is isolated with the finger to the upper limit of the incision (Fig. 1430), drawn down somewhat out of the ring,

clamped only sufficiently tight to control hæmorrhage, and cut off about half an inch below the point of seizure. The three arteries of the cord (Fig. 1451) are each tied independently with catgut. The veins also should be tied. The outer surface of the cord is then seized at either side with forcipressure to prevent its undue retraction and to provide the means of withdrawal from the ring if hæmorrhage happen after removal of the clamp. Remove the clamp, examine the stump for bleeding, and, if none be present, remove the forcipressure and permit the cord to retract. The borders of the wound are now brought together accurately and stitched with catgut or silkworm gut, leaving room below for the introduction of drainage if needed. If the need of removal of the sac and testicle be self-evident, it can be readily accomplished without exploration by exposing above the cord through a free incision and separating the tissues downward along the cord, pushing the tunic and the testicle upward through the incision. This course limits the extent of the cutaneous wound and correspondingly lessens the extent of the sewing, dangers of infection, etc. If the bottom of the scrotum be buttonholed, ample opportunity for the establishment of drainage requirements is afforded. The cord is treated the same as in the preceding instance and the incision closed by sewing.

*The Remarks.*—If the scrotal integument be involved, an eliminating elliptical incision should be made (Fig. 1430). Redundant integument should be removed if much relaxed or of exceeding amount. If the disease be non-infective, the incision may be made as brief as possible. If a hernia be present, a radical cure can be performed at the same time if not contra-indicated.

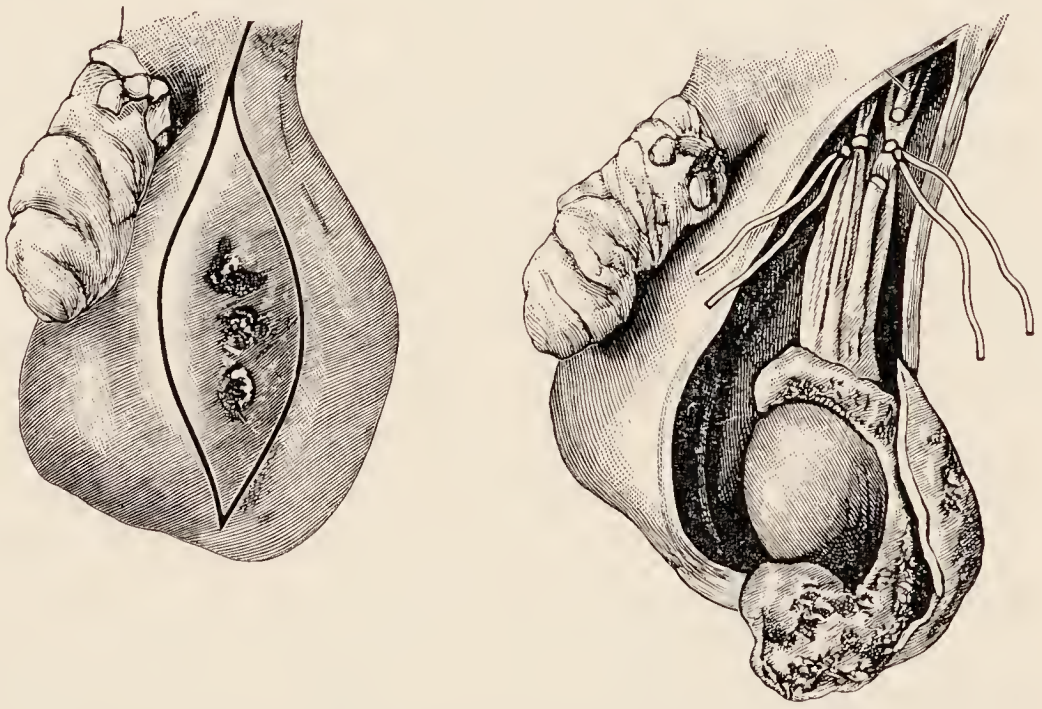


Fig. 1430.—The operation of castration with involvement of scrotal tissue. Penis wrapped in aseptic gauze.

*The Precautions.*—Care should be exercised to detect the presence of a hernia at the seat of operation, for apparent reasons. In malignant disease the lymph nodes directly associated with it should be removed, whether enlarged or not. Cauterization of the end of the vas deferens should be practiced if it be infected by disease extension. The incautious division of an overstretched cord will cause the stump to disappear promptly out of reach. Therefore, division of the cord during manual or tumor-weight traction should be carefully avoided. Neuralgia and secondary hæmorrhage may follow the tying of the cord *en masse;* the former may arise from transfixion of the cord. High division of the cord should be practiced in the instance of malignant disease.

In non-infective cases it may be tied within an inch or so of the testicle, if feasible. Retention of urine sometimes follows castration, and the liability of its occurrence should always be anticipated and provided for. Care should be exercised in uniting the borders of the wound, or the movements of the dartos will disarrange the coaptation. The writer practices the introduction through the borders of three or four deep sutures for the purpose of better controlling these movements, after which the more superficial sutures are applied and proper adjustment of the cut borders secured. Strong lotions should not be used in washing the scrotum, as they often cause acute suffering and severe irritation.

*After-treatment.*—The wound is drained, dressed, and attended thereafter in the manner characteristic of aseptic treatment. When employed, drainage is removed at the first dressing; the sutures at the end of the first week. Strapping may be needed to complete the deep healing satisfactorily.

*The Results.*—The danger to life when done for malignant disease is about 2 per cent. About 12 per cent remain free from return for more than three years. Castration is employed for chronic prostatic enlargement (page 1142).

**Orchidopexy.**—Orchidopexy relates to the bringing down into the scrotum and retaining of an incompletely descended testicle. This plan is not attempted until after failure of simpler means and the lapse of time render operative steps advisable. The external ring is exposed through a free incision, which is extended upward or downward, as circumstances require, to reach the testicle. The testicle is seized and drawn downward, while the cremaster muscle and other unimportant restraining tissues are divided by careful dissection. The scrotal structures are then separated by blunt dissection so as to form a suitable nidus for the deposit of the organ, after which it is retained in position by wrapping around the cord between the external ring and the testicle the contiguous scrotal folds and securing them in place by sutures. The successful attainment of these steps is not as easy nor finally as satisfactory as might appear from the description. Instrumental restraint is advised after the operation to retain the organ in place while awaiting the gain arising from increasing growth. The unsatisfactory outcome that has so often followed these efforts of restoration has prompted the selection by some operators of other means of treatment. *Dawbarn* advises the raising and planting of the testicle so deeply beneath the tissues at the internal aspect of the inguinal canal that it will be removed from harm and also escape the dangers attendant on scrotal implantation.

*Dowd*, with the view of gaining as much as possible in length of the cord, shortened its course by division of "the transversalis fascia from the internal ring downward to the pubic bone." This course obviated the restraining influence of the vas deferens. The remaining restraint was quite overcome by careful division of the cremaster muscle, supplemented with gentle traction on the cord and testicle. By these means the organ could be secured below the pubic bone by stitching to the scrotum. The incision in the fascia was sutured, and after healing a truss was worn for three months to prevent retraction. At the end of a year the parts were in their normal relation.

*The Remarks.*—In the division of the restraining tissues of the cord, injury to the vessels and nerves and the vas deferens should be carefully avoided. In the instances in which the undescended testicle is functionally useless, and only sentiment urges orchidopexy, the removal of the misplaced organ and the introduction of a false one into the scrotum may satisfy the sensibility of the patient, and relieve him, at the same time, of the annoyances and dangers from the imprisoned organ.

**Circumcision.**—Circumcision is practiced when phimosis or an uncomplicated redundancy of the foreskin exists, to relieve the patient's pain and annoyance from these conditions. The patient is placed on the back, and

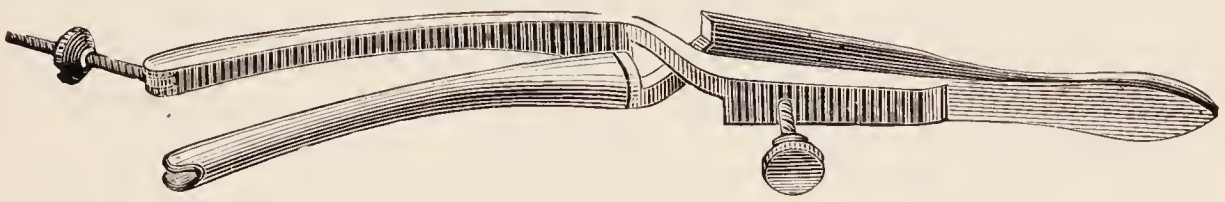


Fig. 1431.—Henry's phimosis forceps.

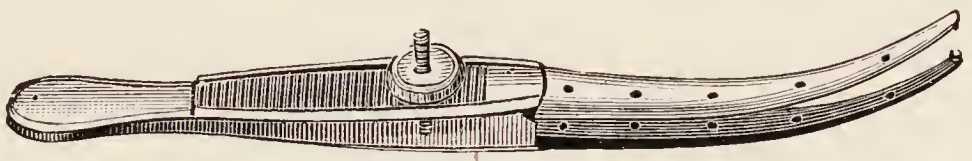


Fig. 1432.—Fisher's phimosis forceps.

general or local anæsthesia administered. The object of the operation is not to remove the foreskin so as to leave the entire glans penis exposed after recovery, but to allow sufficient integument to remain to afford the protection characteristic of the normal prepuce. The situation of the base and apex of the glans should be determined, and with a pen or pencil an oblique line is drawn corresponding to the direction of the base of the glans, about midway between it and the apex, upon the integument (Fig. 1439). The foreskin is then drawn downward, placed between the blades of the clamp (Figs. 1431 and 1432), with the line just made corresponding to the lower border of the blades, care being taken not to include the glans in the grasp (Fig. 1433). The clamp is tightened, and the distal portion severed by a scalpel or scissors (Fig. 1434). The clamp is then removed (Fig. 1435), when the integument retracts to or a little behind its previous location (*a*). The mucous membrane, which still covers the glans, is slit up on a grooved director, along the dorsum to the corona (*b*), and trimmed symmetrically on either side, not even with the integument (*c*), but near enough to it so that when it is turned over and its free borders are stitched to the skin, a vermilion border (*d*), at least a third of an inch wide, is formed. Before the sew-

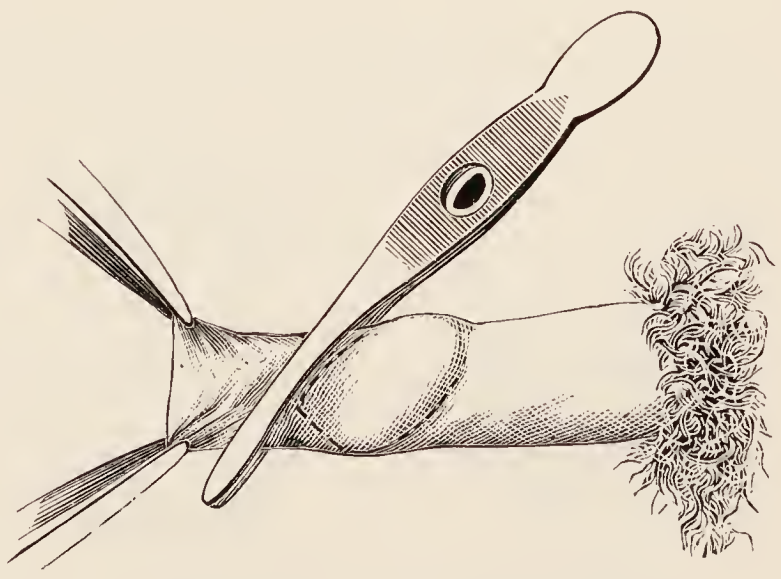


Fig. 1433.—Clamping foreskin.

ing is done, the mucous membrane should be stripped off the glans to a point behind the corona, all smegma removed, and the part cleansed, after

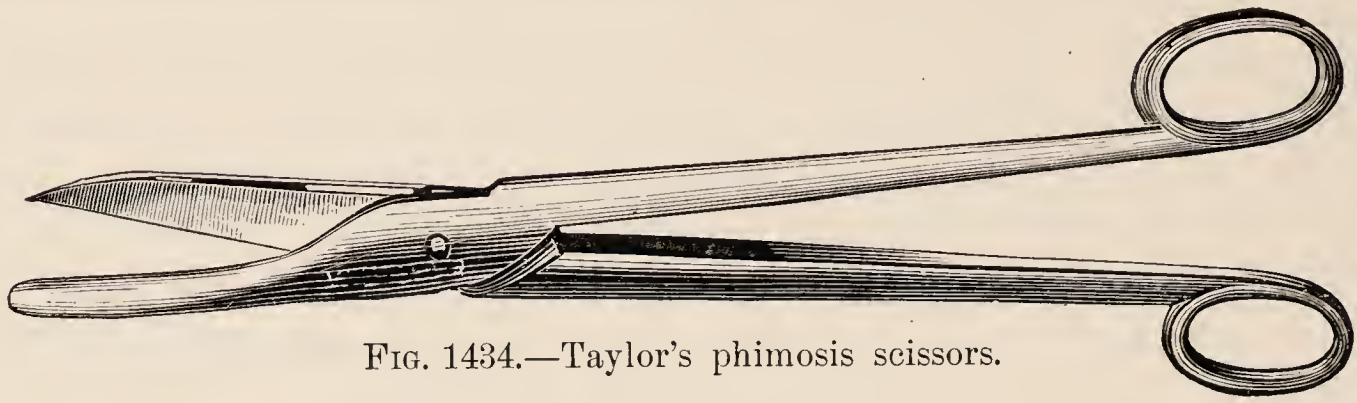


FIG. 1434.—Taylor's phimosis scissors.

which the mucous sleeve is returned to place, and its border joined to that of the integument by an interrupted or continuous fine catgut suture. If the mucous membrane grasp the glans too tightly, thus predisposing to the occurrence of paraphimosis, it must be slit on the dorsal surface up to its point of reflection, after which the borders are joined as before described. The final division of the membrane at the dorsum will permit the prepuce to accommodate itself to the varying dimensions of the penis that occur not infrequently during the process of healing.

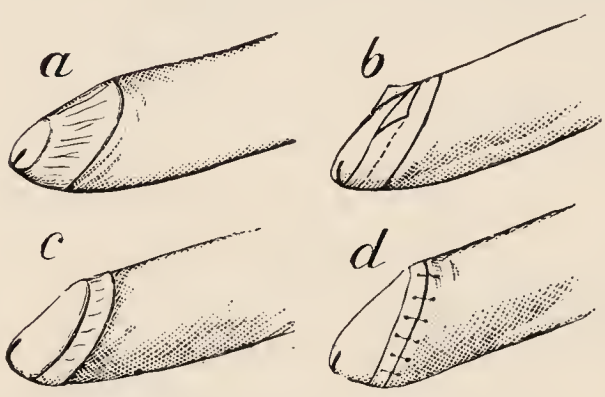



FIG. 1435.—Steps of circumcision.

**Keyes's Method.**—*Keyes's* method is an admirable one (Fig. 1436), and is intended to meet the same reparative indications as the preceding. In this the mucous membrane is not slit up, but both it and the integument are shaped to correspond to the outlines *a*, *b*, *c* and *d*, *e*, *f*, respectively, after which the former flap is reflected backward and joined to the integument, so that *b* shall correspond to *e*, *a* to *d*, and *c* to *f*. This plan does not, however, insure the same freedom from constriction as does the long dorsal slit just described. If the phimosis be not attended by an elongation of the foreskin, a cure may be effected by slitting up the dorsal

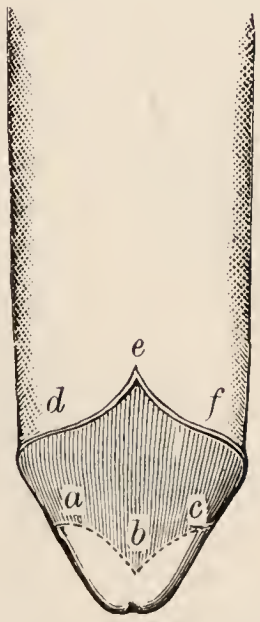



FIG. 1436.—Keyes's modification.

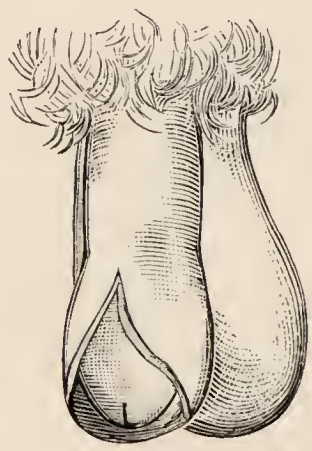


FIG. 1437.—Dorsal slit.

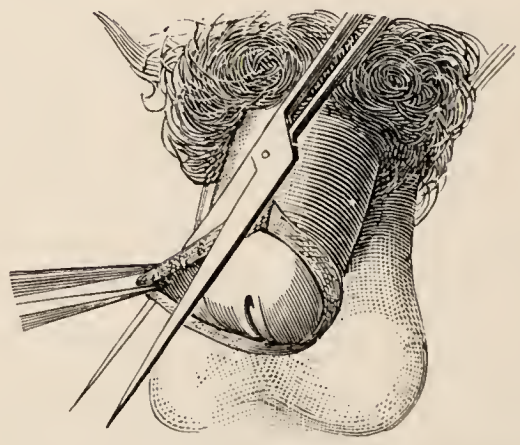


FIG. 1438.—Trimming foreskin.

surface on a director to the base of the glans (Fig. 1437). The earlike projections on either side are then trimmed off (Fig. 1438), and the mucous and cutaneous borders stitched to each other with catgut. *Roser's* trian-

gular-flap method is easily performed and of serviceable outcome. A dorsal division of the prepuce is made with scissors or a director and pointed scalpel. After the division the outer layer of the prepuce retracts more than the inner (Fig. 1439). The inner layer is then divided at either side obliquely outward to the border of the glans, and the small triangular flap thus formed above is turned over into the angle formed by division of the outer layer and sutured in place. After suitable trimming of the earlike angles of the outer layer, the corresponding borders of the two layers are sutured together. *Cullerrier*, after thorough cleansing of the subpreputial space, accomplished well the purpose in this condition by subcutaneously dividing the mucous membrane in three or four places by means of blunt-pointed scissors; the blunt point resting upon the glans, while the sharp one was passed between the membrane and the integument. If the prepuce be short, and the case not an aggravated one, the *mucous lining may be stretched*, and even torn asunder, by introducing the blades of dressing forceps between the glans and foreskin and expanding them, after which the foreskin is drawn backward and retained until healing is completed.

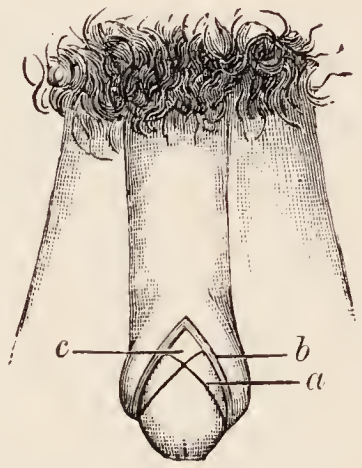



Fig. 1439.—Roser's operation for phimosis. *a*. Inner layer of the prepuce. *b*. Cut edge of the outer layer. *c*. Triangular flap formed from the inner layer by two oblique incisions.

*The Precautions.*—If too much tissue be left at the frenum, a disfigurement follows of annoying duration. If forcible traction be made on the foreskin before its severance, the integumentary portion will be made much too short. If the foreskin be adherent to the glans, and the preputial orifice be small, the grooved director may be carried into the urethra and the glans divided. If commendable cleanliness be not exercised in this operation and maintained in the treatment, troublesome cellulitis may follow. The doctrinal method of practice is sometimes followed by this complication.

*The Remarks.*—Fine catgut, continuous or interrupted sutures, should be employed in sewing, and the stitches should be placed as near to the borders as possible, so that they will cut their way out without pain or disfigurement, thus forestalling the annoyance of removal. Horsehair is sometimes used in sewing the borders together. Only trifling hæmorrhage occurs in adults; in infants scarcely any. Sometimes in infants the tissues are permitted to heal without suturing; and often, too, in infants the dorsal slit completes the operation.

*The After-treatment.*—The after-treatment in all the methods of operation is directed to modifying the inflammation, preventing the occurrence of erection of the penis, and keeping the parts clean.

The wound is dressed at first by surrounding it with a narrow piece of dry aseptic iodoformized gauze drawn closely in place and carried upward so as to cover the entire organ. After a day or so this dressing can be soaked off by placing the patient in a warm tub bath or by gentle irrigation with warm sterilized water, followed by the same treatment as often as clean-

liness and comfort require. The penis should be supported by a textile fabric ring within which it rests, and the clothes should not be permitted to come in contact with the sensitive glans. A capacious cradle interposed for this purpose meets the indication and at the same time affords good ventilation. All constriction of the organ should be prevented, to obviate the œdema of the parts which will surely follow. In the adult a cold-water rubber coil carried around the penis may prevent erection and the pain and tearing of the tissues incident to this happening. The application of oleaginous substances should be limited to the glans and borders of the dressing exposed to wetting with urine. The application of collodion to the borders of the wound is objectionable on account of the contraction attending fixation. If stitch irritation does not take place, the stitches may remain until released by absorption. Troublesome erections may be palliated, if not prevented, by the use of cold, dry applications.

In one case we now recall, local and general medication combined were not sufficient to control or hardly mitigate the tendency to erections; however, the complication was effectually met by employing a nurse to watch the organ while the patient slept, with instructions to awaken him on the appearance of the first indication of an erection.

*The Results.*—The danger to life or to the integrity of the organ is scarcely entitled to the dignity of mention if aseptic measures be practiced throughout. If healing by granulation takes place, or the operative technique be faulty, the preputial opening may become too small and be rigid and unyielding.

**Paraphimosis** (Fig. 1440).—In paraphimosis the foreskin is firmly lodged behind the corona glandis, so as to cause great congestion, œdema, and sloughing of the parts if not relieved (Fig. 1441), and the condition may even terminate in gangrene and sloughing. *The reduction* of the foreskin may be accomplished in the following manner:



Fig. 1440. Paraphimosis.



Fig. 1441.—Results of the constriction.

Oil the parts well, and administer an anæsthetic if necessary; grasp the penis behind the constriction with the thumb and fingers of the left hand, and the glans with the tips of the thumb and fingers of the right; press the glans with the latter gradually to reduce the swelling, then draw the constriction forward with the left, while the glans is gradually forced through it with the thumb and fingers of the right (Fig. 1442). If the constriction be not great, and the œdema and congestion be moderate, this manipulation will soon effect the reduction. In all cases where much œdema exists, acupuncture should be performed, and the fluids squeezed through the openings before reduction is attempted. When the

part is corrugated and much swollen by long-standing severe constrictions, followed by inflammation and plastic œdema, and perhaps by incipient gangrene, it will be necessary to sever the constriction freely on the dorsal surface by a sharp-pointed, curved bistoury (Fig. 1443). Other methods of grasping the penis are recommended to effect the reduction of the foreskin (Figs. 1444 and 1445).



FIG. 1442.—Paraphimosis. First method of reduction.

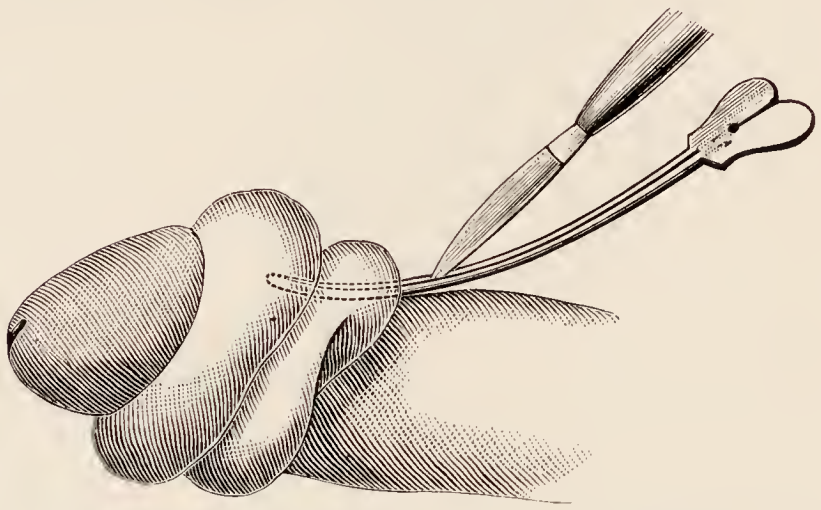


FIG. 1443.—Slitting up the constriction on a grooved director.

*The Comments.*—The employment of specially devised instruments to compress the distended glans is a refinement of needless birth. The elimination of œdema by acupuncture followed by elevation of the organ and by hot, soothing applications, will very often prepare the way to prompt reduction. However, if impending sloughing be noticeable, free and prompt division of the constriction, followed by the palliative measures, will secure the promptest and most satisfactory results.

*After-treatment.*—Following reduction, thoroughly cleanse and disinfect the parts; place the patient in bed, with the penis elevated and supported, and dress with soothing antiseptic lotions.

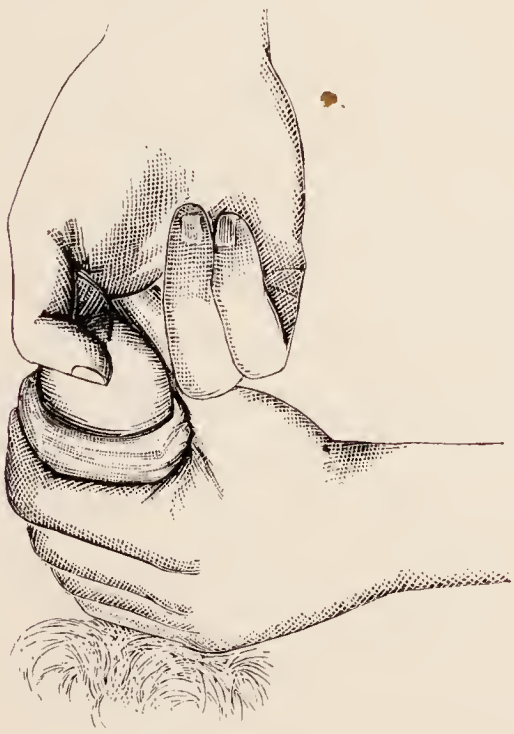


FIG. 1444.—Paraphimosis. Second method of reduction.



FIG. 1445.—Paraphimosis. Third method of reduction.

**Amputation of the Penis.**—Amputation of the penis is commonly practiced for the purpose of removal of malignant disease.

*The Anatomical Points.*—The organ is abundantly supplied with blood-vessels and lymphatics, and well suited, therefore, to malignant spread from the anatomical standpoint. The arrangement and relations to each other of

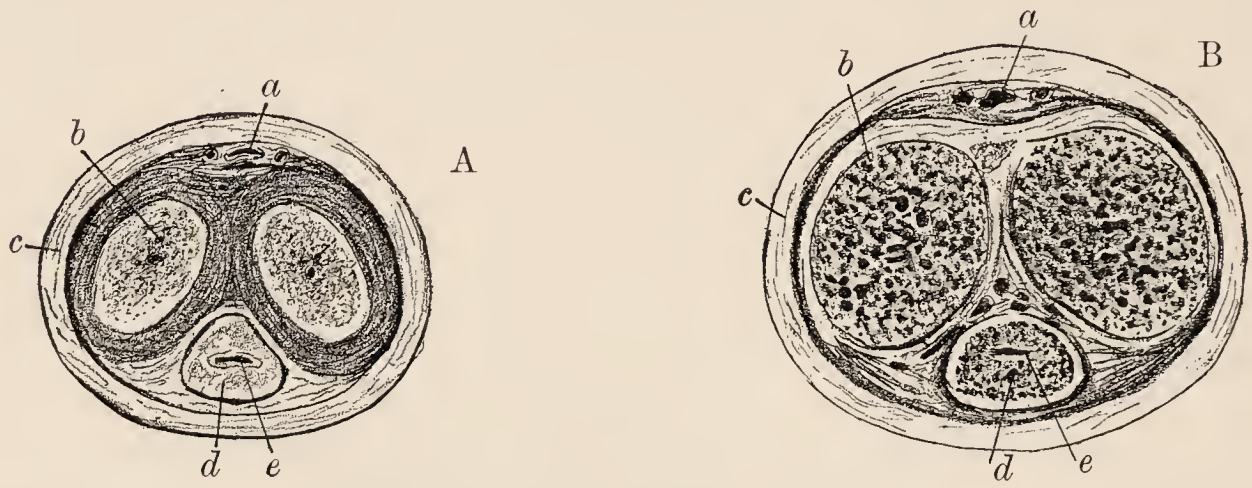



FIG. 1446.—Cross section of the penis. A, in flaccid, B, in erect condition. *a*. Dorsal veins and artery of penis. *b*. Network of corpus cavernosum. *c*. Skin of penis. *d*. Network of corpus spongiosum. *e*. Urethra.

the important vessels and structures is better shown by the illustration (Fig. 1446) than words can depict.

Prepare the sound portion of the penis, the pubes, and scrotum for operation by aseptic measures; cleanse and surround the diseased portion with antiseptic gauze; empty the bladder, place the patient on the back and administer an anæsthetic.

*The Operation.*—Introduce a sound into the urethra and give it in charge of an assistant; pass the rubber band firmly twice around the base of the penis and clamp or tie the ends, to control the circulation (Fig. 1449); hold the penis lightly and conveniently with the hand; divide the integument with a circular cut around the penis with a scalpel; divide the corpora cavernosa vertically down to the corpus spongiosum; isolate the corpus spongiosum forward for an inch; remove the sound and cut off the spongy body at the anterior limit of exposure; tie the open mouths of the vessels and remove the rubber constriction; arrest further bleeding and slit up the urethra for three fourths of an inch at the lower surface and turn up the resulting flap; snip off the angles at the upper border and join the margins of the urethral flap to the integumentary with fine interrupted catgut sutures, being especially careful to get good juxtaposition below to prevent urinary infiltration; draw the integument backward so as to bring the flaps in firm contact with the divided ends of the corpora cavernosa, putting a catgut suture deeply through at either side to hold them in place; introduce a soft-rubber catheter into the bladder, clamp the end and fasten it there; surround the stump of the penis with aseptic gauze held firmly in place with the catheter protruding through it, and fastened in position; support the scrotum and the dressing with an apron or T-bandage; attach to the catheter a small rubber tube, causing it to pass beneath the surface of an antiseptic fluid contained in a vessel placed (Fig. 1315) beneath the bed. The dressing is changed when soiled and a fresh dressing applied. The cases thus far treated in

this manner by the writer have healed promptly by first intention, and the dressing has been dispensed with in a week's time. *Treves* advises that the urethra be slit along the dorsum, turned down, and the lower end stitched to the integument below, which is made longer for this purpose. The sides of the flap are sutured to the corpora cavernosa. The mode of dressing is substantially the same, and in both instances the skin turns inward and forms a puckered prepuce at the end of the stump.

*The Flap Method of Amputation.*—An excellent stump and rapid healing follow this method. After the proper control of the vessels, extend the penis gently and enter a narrow-bladed knife at a point well removed from the disease, between the corpus spongiosum and the corpora cavernosa, and cut forward and downward through the tissues, making a flap about three fourths of an inch in length, from which the urethra is then dissected. Make a long oval-shaped flap from the dorsum and sides of the penis of much greater length than that of the first; reflect the flap back and divide the corpora cavernosa vertically downward to the point of transfixion (Fig. 1447); remove the rubber constriction; secure the bleeding points; puncture the upper flap at the middle; carry the urethra through the opening and sew its extremity to the edge of the slit and the borders of the flaps to

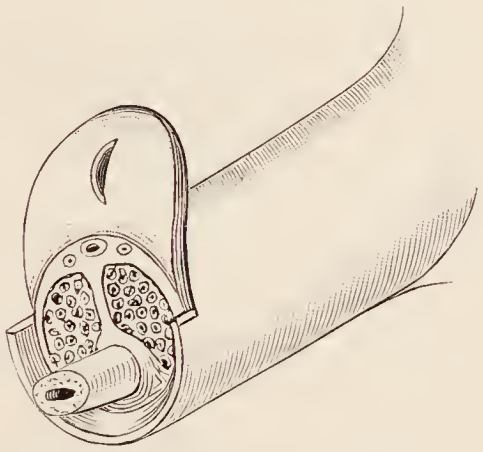


FIG. 1447.—Amputation of penis. Long superior oval-shaped flap. Short inferior flap.

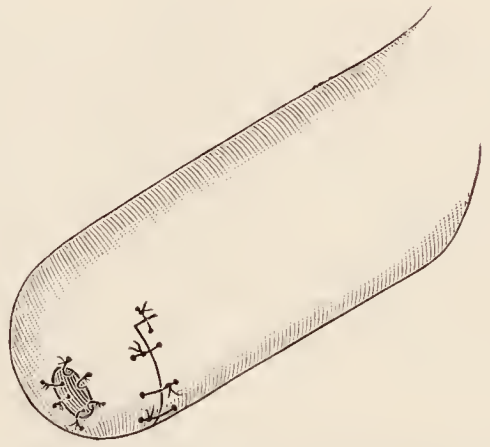


FIG. 1448.—Amputation of penis. Flaps united and urethral opening fixed.

each other with catgut (Fig. 1448). Introduce the catheter and dress and treat as in the preceding method.

*Hilton* modified the operation by dividing the spongy body about a fourth of an inch in front of the cavernous portion, splitting it longitudinally, and uniting the lateral flaps thus formed to the integument.

*Humphrey* turns back from the integument of the penis a circular flap about half an inch in length, divides the corpora cavernosa on a level with the attachment of the flap, and cuts the spongy body at least half an inch longer than the cavernous bodies, and attaches the integument to its extremity.

*An old method* of practice, now rarely employed, consists in transverse division of the organ (Fig. 1449, *a*), followed by suture of the borders of the divided end of the urethra (*b*) to those of the severed integument (*c*). A catheter is introduced into the urethra, and the raw surfaces are carefully apposed to each other by means of suitable dressings.

*Thiersch* amputated the penis at the pubes, split the scrotum, divided longitudinally the corpus spongiosum the distance of an inch, and brought the free end of the urethra out of a wound made in the perinæum an inch and a half in front of the anus, to the borders of which the extremity of the urethra was stitched.

*Davies-Colly* amputated the penis at the scrotum; then, through an incision made into the posterior scrotal rhaphe down upon the urethra, he isolated the corpus spongiosum, brought the divided extremity out through the opening, and stitched its borders to those of the incision.

*The Precautions.*—If the amputation is to be made close to the symphysis, retraction of the stump and infiltration of the scrotum with urine must be guarded against. If a stout ligature be passed through the fibrous sheath of the penis, a little above the point of proposed section, the stump can be controlled and the first accident, and possibly the second, will be obviated by this means. At all events, the infiltration can be prevented by dividing partly or entirely through the scrotum and the floor of the urethra, in the

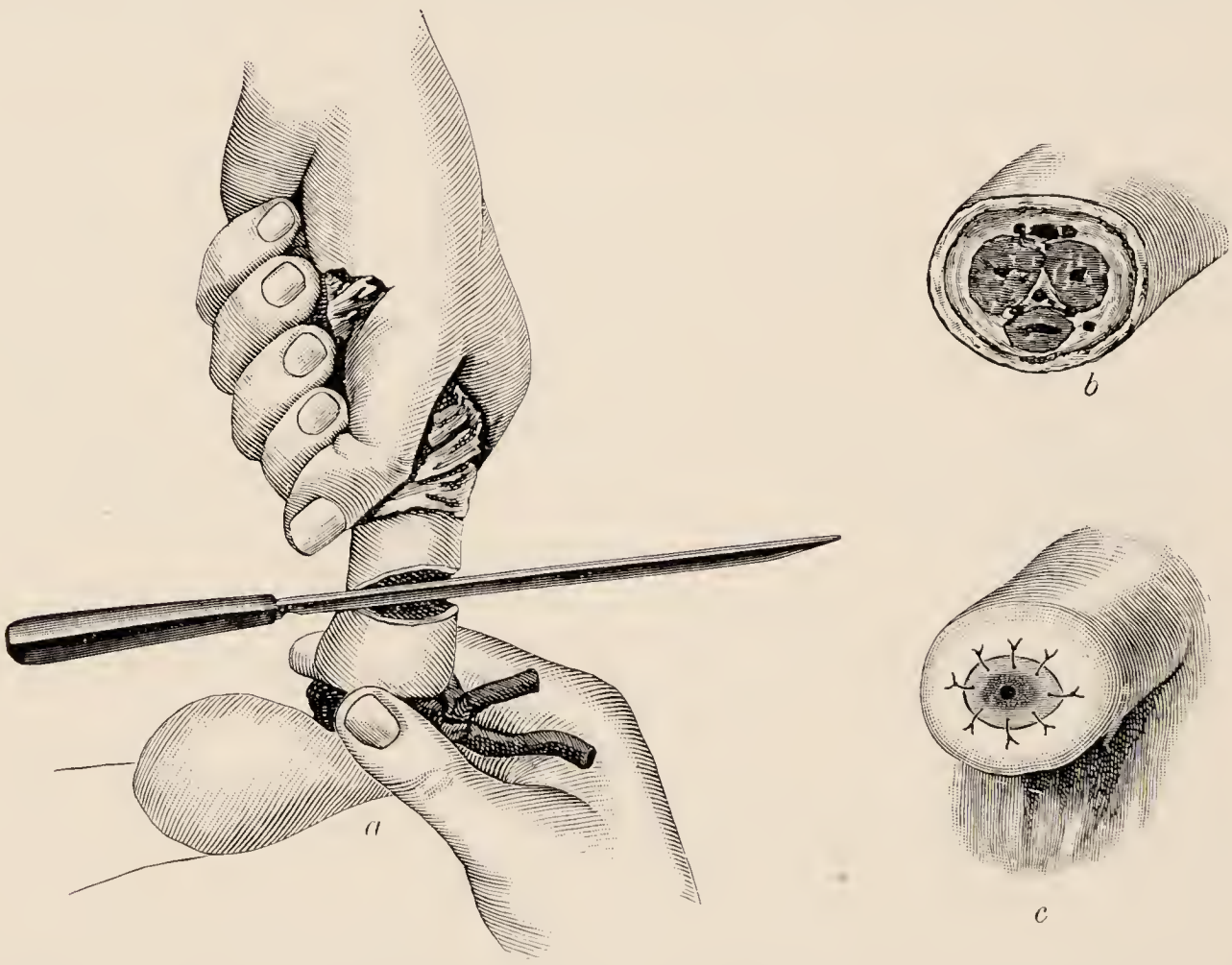



FIG. 1449.—Amputation of penis by transverse division. *a*. Act of amputating organ constricted with rubber tube. *b*. End of stump, showing vessels, urethra, and cavernous bodies. *c*. Integument united to urethra.

line of the urinary canal, and uniting the borders of the integument to those of the urethra so as to form two scrotums (Fig. 1450), with the urinary opening between them. A disarrangement of the drainage or withdrawal of the catheter by traction on the tube often leads to prompt saturation of the dressings. If the patient be intractable in this respect, the catheter is employed every four or five hours, and it may be withdrawn entirely or only partially after each introduction, as may be deemed essential. If complete withdrawal be practiced, a long silkworm-gut suture should be stitched at the

outset to the floor of the urethra as a guide to the opening. Infiltration of urine between the flaps should be studiously avoided. If the line of junction be smeared with iodoformized vaseline with each dressing, the liability to this complication is considerably lessened. The lymphatic nodes in the line of the lymph flow of the penis, whether enlarged or not, should be sought for and removed at once in malignant disease. In every case careful stated periodical surveillance should be exercised after operation, in order to detect and eliminate the earliest manifestations of lymphatic involvement or disease recurrence. It is wise, too, to subject the lymph nodes to microscopical examination, to determine in them the presence of malignant processes.

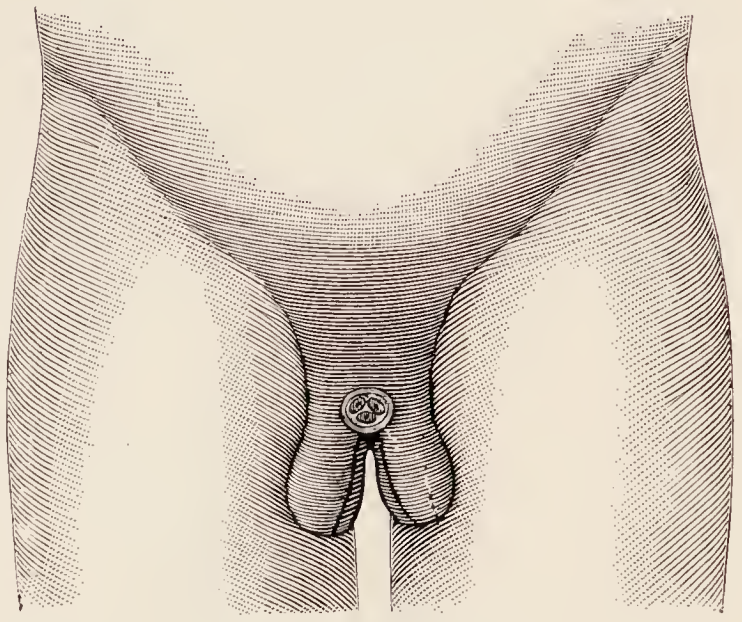


FIG. 1450.—Amputation of penis close to scrotum. The latter split and divided borders sewed together, inclosing testicles.

*The Remarks.*—The scrotum and the wound should be kept clean, and the former frequently anointed with vaseline to prevent irritation. If repair by granulation takes place, a structural narrowing of the opening may follow. Transfixion sidewise of the corpora cavernosa with a long needle, and application of the constricting agent behind it, is advisable if a short stump is to be formed, as then the latter is better controlled and prevented from retracting into the soft parts. Do not amputate within three fourths of an inch of the disease, if avoidable.

**Extirpation of the Penis.**—Extirpation of the penis is practiced only when the disease is extensive and no complications are present that forbid the operative technique.

*The Operation* (Gould).—Cleanse the parts thoroughly; place the patient in the lithotomy position; incise the scrotum in the median line the entire length of the rhaphe; separate the scrotum into halves (Fig. 1450) quite down to the corpus spongiosum with the finger and handle of the scalpel; introduce into the urethra, down to the triangular ligament, a full-sized sound or catheter; insert a long, thin-bladed knife transversely between the corpus spongiosum and the corpora cavernosa; withdraw the instrument from the urethra; sever the urethra at the pubes and detach it backward to the triangular ligament; make an incision around the root of the penis continuous with the one in the median line; divide the suspensory ligament and separate the penis, except at the attachment of the crura, with a scalpel; disconnect each crus from the pubic arch with a periosteal elevator; ligature the bleeding vessels; slit up the corpus spongiosum for about half an inch; raise the edges of the divided urethra and stitch them to the back part of the scrotal incision; close the remainder of the scrotal incision with sutures, and establish through-and-through drainage in the deep part of the wound. A catheter is not used. The wound is cleansed and dressed in the usual manner.

*The Remarks.*—Extensive glandular involvement and enfeebled reparative power contraindicate the operation.

**Gouley's Method.**—In Gouley's method make a curvilinear incision at either side of the root of the penis, beginning in the median line, about an inch and a half above the level of the pubes and ending a little below the peno-scrotal junction. The cavernous bodies are exposed and transfixed with a large knitting needle or with a suitable substitute; the urethra is transfixed by a smaller instrument of like nature on the same plane, and the penis is amputated an eighth of an inch in front of them. After all the bleeding points are secured, a grooved staff is introduced through the urethra

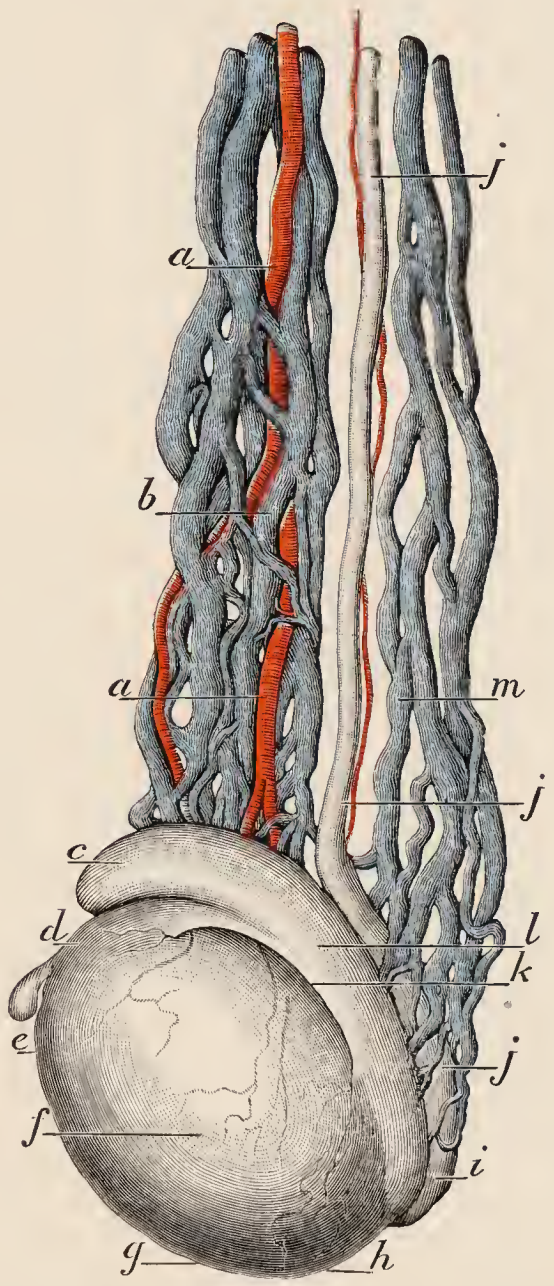



FIG. 1451.—The vessels of left testis and cord (outer surface). *a, a.* Spermatic artery. *b.* Anterior spermatic veins surrounding artery. *c, l, i.* Head, body, and tail of epididymus. *d.* Anterior extremity of (with hydatid of Morgagni), *e, g,* antero-inferior surface of, *f,* outer surface of, *k,* postero-superior surface of, and *h,* postero-inferior extremity of testicle. *j, j, j.* Vas deferens and its artery. *m.* Posterior spermatic veins.

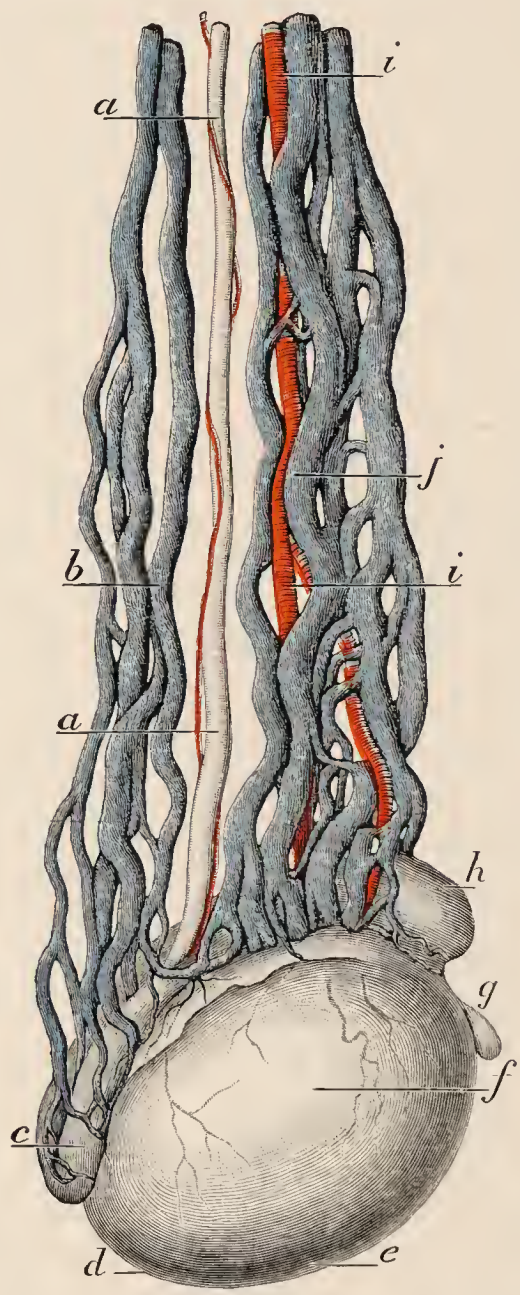



FIG. 1452.—The vessels of left testis and cord (inner surface). *a, a.* Vas deferens and its artery. *b.* Posterior spermatic veins. *c, h.* Tail and head of epididymus. *g.* Anterior extremity of testis and hydatid of Morgagni. *f.* Inner, *e,* antero-inferior, *d,* postero-inferior surfaces of testis. *i, i.* Spermatic artery. *j.* Anterior spermatic veins surrounding artery.

into the bladder. A sharp-pointed scalpel is then carried through the perinæum and lodged in the grooved staff, and all the tissues, including the scrotum, are divided from behind forward. The urethral cut is about an

inch and a half in length, and the cutaneous one three inches. The urethra is now detached from the cavernous bodies, which, together with their crura, are dissected away, after which the borders of the urethra are united to those of the perineal wound. The testicles are inclosed separately in the scrotal tissues at either side of the perineal incision, by sewing together their divided borders (Fig. 1450).

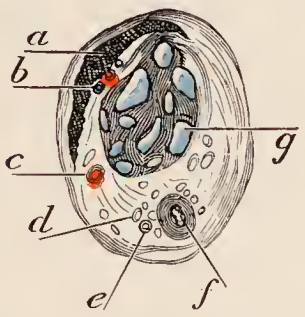



FIG. 1453. — Transverse section of cord at left abdominal ring. *a*. Cremaster muscle. *b*. Cremasteric vessels. *c*. Spermatic artery. *d*, *e*. Vessels of the vas deferens. *f*. Vas deferens. *g*. Pampiniform plexus, i.e., spermatic veins.

*The Results.—Butlin* reports 53 cases of simple amputation with one death. In extirpation the rate is about 6 per cent. Of 65 cases 23 had passed successfully the three-year limit. Urination is quite well done and intercourse may be fruitful except in cases of extirpation.

**Varicocele.**—Varicocele is a term applied to a varicose state of the veins of the spermatic cord. The veins here, as in other parts of the body, may be little or much distended, calling, therefore, for either the palliative or radical method of treatment.

*The Anatomical Points.*—The vas deferens, the three arteries, and the two sets of veins constitute the most important structures of the cord. The vas deferens is a round, white, firm, incompressible structure, an eighth of an inch in diameter, easily recognized, as it lies at the posterior aspect of the spermatic cord. The spermatic artery lies in front and (Figs. 1451 and 1452) the artery of the vas at the side of the vas deferens, and the cremasteric artery among the superficial layers of the cord at the outer side. The spermatic veins and those of the vas run upward, the former being the larger, the more numerous, and lying in front; the latter the smaller, and attendant on the vas deferens. The veins of the left are larger than those of the right side, and usually the spermatic veins of either side are affected much oftener than are those of the vas deferens. An abundance of connective tissue is present between the structures of the cord. Spencer's cut illustrates the relation of the structures in an admirable manner (Fig. 1453).

**The Palliative Treatment.**—The palliative treatment consists in raising the scrotum and its contents, thus lessening the traction on the cord of the column of blood contained in the vessels. This plan of treatment is effected by the various forms of suspensories, as Morgan's (Fig. 1454), and the one in common use. If these measures relieve the urgent symptoms, an operation may not be desired. If, however, the characteristic symptoms recur or continue, then, if preferred, the palliative operation of shortening the scrotum by excision can be performed.

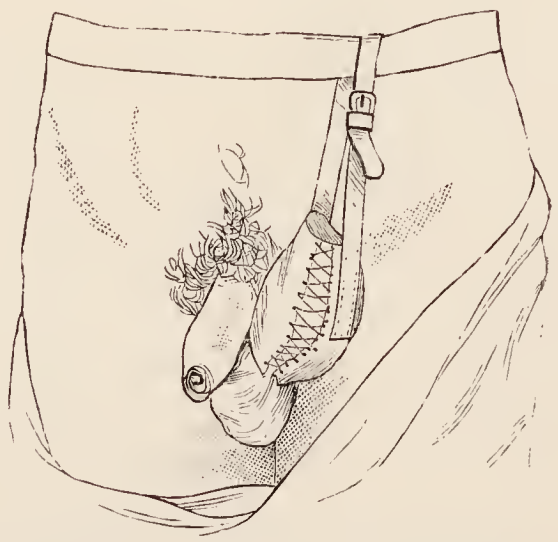


FIG. 1454.—Morgan's suspensory.

*The Excision of the Scrotum.*—The abridgment of the scrotum by excision of the lower portion and repair of the wound raises up its contents and

thereby relieves the tension on the cord, the same as by the use of a suspensory.

*The Operation.*—Thoroughly cleanse the scrotum and anæsthetize the patient; apply the clamp (Fig. 1455) with the bar (*a*) adjusted to the affected side, nearly parallel with the median rhaphe, by drawing between the blades a sufficient amount of scrotal tissue; press the testicle upward to the external ring to avoid its inclusion by the clamp; tighten the blades of the instrument amply to control the circulation and securely hold the scrotal tissue; transfix the protruding portion of the scrotum on a level with the adjustable bar (Fig. 1455) with a sharp, narrow-bladed bistoury and cut it off; pass the sutures through the divided borders (beneath the bar) before the blades of the clamp are loosened; loosen the clamp and catch and tie the bleeding points with catgut before tying the sutures. Tie the sutures, place the patient in bed, elevate the scrotum, and dress the part with gauze. The wound usually heals quickly, and the result affords a relief that amply recompenses the patient for the annoyance incurred. If the clamp just described be not at hand, the operation should not be rejected for this reason, as a clamp of practical utility may be extemporized from long-handled forceps, or by adjusting to the scrotum two narrow bars of metal or stiff wood, the extremities of which can be firmly held by elastic bands or by the hands of an assistant.

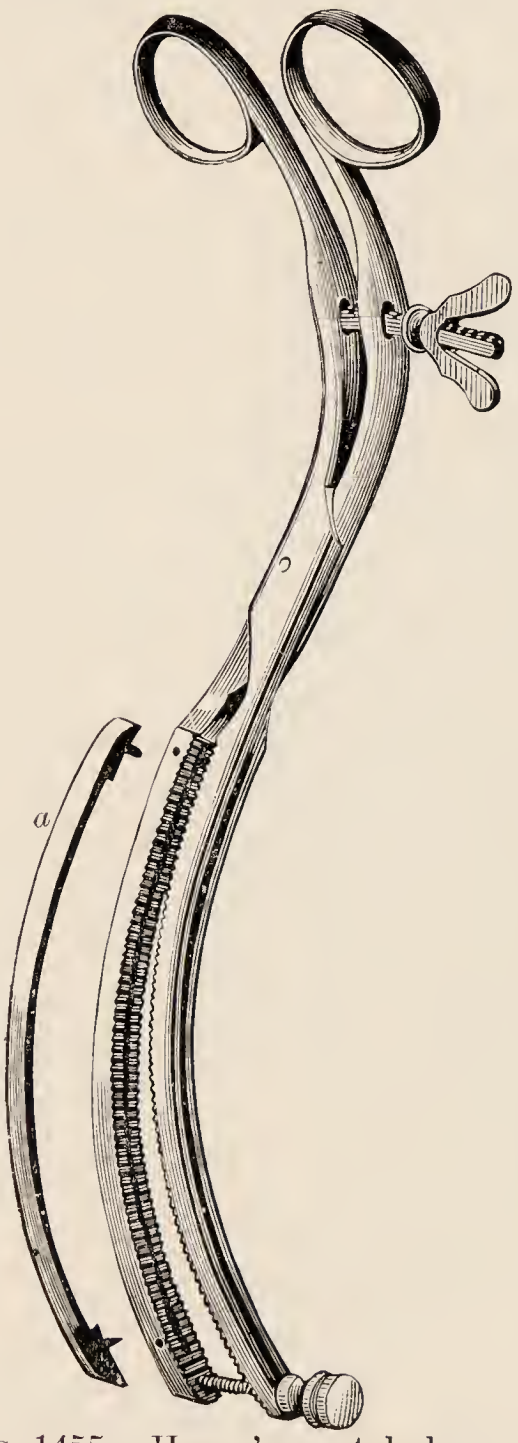


FIG. 1455.—Henry's scrotal clamp.

*The Precautions.*—Care should be taken to arrest all bleeding points before the borders of the wound are united, to avoid the extensive extravasation of blood that the loose tissue of the scrotum invites. In case extravasation happens, the blood should be removed at once from the tissues and the bleeding point found and tied.

**The Radical Treatment of Varicocele.**—The means employed to obliterate the dilated vessels are quite numerous. They all, however, accomplish the result by compression. Only such as are considered consistent with the safety of the patient are here described. It will be noted that in some instances the operation is an open one—the vessels being reached through one or more free incisions. In others, puncturing only is practiced for this purpose.

In each of the operations great care must be exercised to avoid the vas deferens and artery. Therefore it is proper to repeat the fact that they lie posteriorly to the enlarged and wormlike congeries of vessels (page 1453), around which the compression is usually applied. If the patient be caused

to lie down with the hips elevated, the blood will return from the varicose veins into the general circulation, after which the vas deferens and the artery can be easily isolated and separated from the veins. If the patient then assumes an erect position, the veins will again become distended; after which, if pressure be maintained upon the cord at the external ring by any effective agency, the vessels can be distinctly outlined with the patient placed again in the recumbent position. The operator having thus carefully isolated the vas deferens and the artery, the patient can be etherized and the operation performed.

*The Compression with Pins* (Fig. 1456).—Compression with pins consists simply in passing a strong pin through the scrotal tissues in front of the vas deferens and the artery and behind the varicose veins, and throwing around its protruding extremities, so as to include the tissue in front, an elastic ligature, or cotton yarn, drawn sufficiently tight to cut off the circulation. This procedure should be repeated at a distance of about one inch

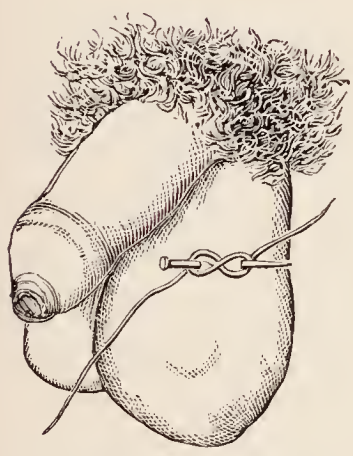


Fig. 1456.—Occlusion by pins.

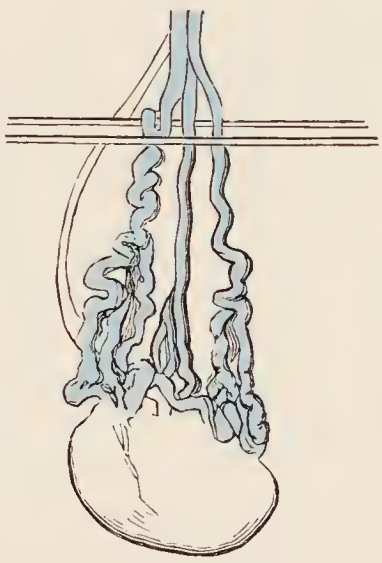


Fig. 1457.—Wires in position. Videl's operation.



Fig. 1458.—Wires twisted. Videl's operation.

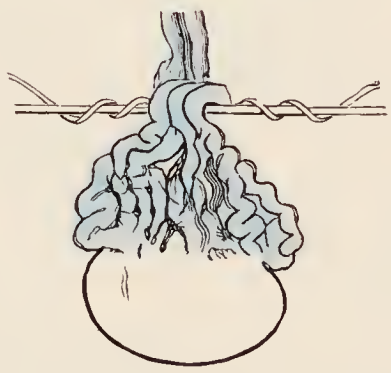


Fig. 1459.—Vessels occluded. Videl's operation.

from the site of the first application. The pins can be withdrawn at the end of three or four days.

*The Compression with Wires* (Videl).—The treatment by compression with wires is made by passing a stout wire either in front of or behind the veins—preferably the latter—then passing a second but smaller one at the opposite side, but through the same opening in the integument (Fig. 1457). The wires are then twisted together till the veins are thoroughly compressed and rolled around them (Figs. 1458 and 1459).

*Erichsen* modified this method somewhat by making an incision half an inch in length at the front and at the back of the scrotum, through which a needle armed with a small silver wire is carried backward in front of the vas deferens and the artery, thence forward beneath the integument around the enlarged veins, and the ends of the wire twisted together so as to constrict firmly the included vessels. Daily tightening of the grasp of the wire is practiced for a week or ten days, or until the vessels are severed by the process of ulceration.

**Subcutaneous Ligaturing.**—Strong catgut ligatures or antiseptic silk can be carried around the dilated veins, at points an inch or so apart, by means of an ordinary needle—or by an instrument especially devised for the purpose—and caused to emerge at the points of entrance, tied, ends cut short, and ligatures permitted to remain until they are absorbed.

*Keyes's Method.*—A needle with a fixed handle, having two eyes at the point, one behind the other (Fig. 1460), is armed with two antiseptic ligatures, one carried through each eye. The ends of the posterior ligature are



Fig. 1460.—Keyes's double-eyed needle.

tied to form a loop; the anterior ligature is permitted to hang loosely, with an equal portion at each side of the needle. The enlarged veins are isolated, and the point of the needle is pushed through the scrotal tissues at one or more situations in close contact with the posterior surface of these vessels (Fig. 1461). One end of the untied ligature is then drawn through the tissues with forceps, and caused to remain in this position, while the needle is withdrawn sufficiently to permit its point to be carried in front of the distended veins, and out again through the original point of exit, when the distal end of the untied ligature is passed through the advanced portion of the looped ligature, and drawn by it backward and out through the point of entrance to the scrotal tissues by the complete withdrawal of the needle. The deposited ligature is then freed from the scrotal tissues by making one or two sharp pulls upon it, tied firmly around the veins, its extremities cut short and allowed to disappear within the scrotum. If thorough antiseptic precautions be observed, the ligatures will rarely cause subsequent local trouble.

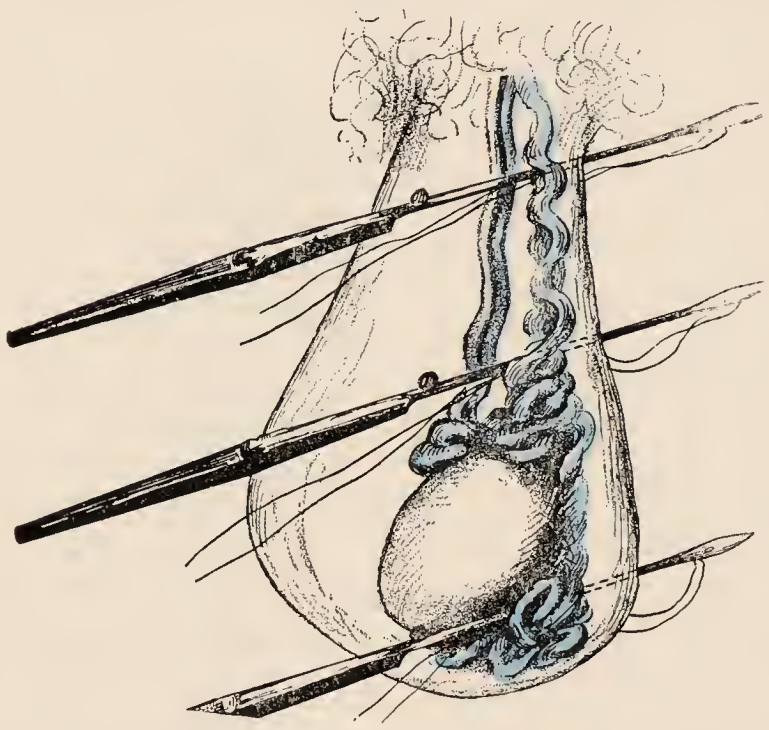


Fig. 1461.—Keyes's operation for varicocele. Passing ligatures with single-eyed needle at different situations.

*The Double-loop Compression of Ricord* (Fig. 1462).—This plan is an excellent one of the kind, and can be readily executed by passing a needle armed with a silk ligature between the veins and the vas deferens and artery; to this is fastened a double ligature, which is drawn through and left in position. The needle with its silk ligature is then passed in front of the veins in the opposite direction, entering and emerging at the points previously made. A second double ligature is then drawn through and left in position. The extremities on the respective sides are now tucked through the loops on the same side, and drawn

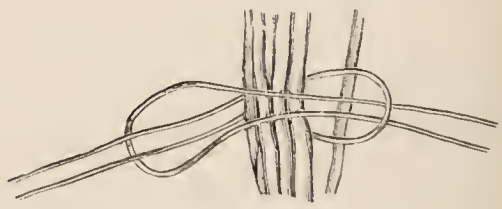


Fig. 1462.—Ricord's loops.

tight and tied over a narrow antiseptic roller or piece of elastic tubing. The ligatures will cut their way through in five or six days.

**Free Incision with Excision** (Howse).—In this operation the superficial veins are exposed by direct incision and careful isolation, and a segment of an inch or so is removed independently, between two catgut ligatures, from each of them.

*The Operation.*—After strict antiseptic preparation in all respects, cause an assistant to grasp and gently draw downward on the testicles of the affected side to make the cord tense; make an incision an inch and a half in length over the most prominent part of the varicocele; draw the borders of the wound apart and carefully expose the veins for an inch and a half by blunt dissection, avoiding severance of the cremaster muscle and exposure of the vas deferens and its vessels; (Fig. 1463) hook up the exposed veins and pass around them, an inch and a half apart, two catgut ligatures; tie the lower ligature first, and remove with scissors the included portion of each vein, after tying the second; wash the cavity of the wound with an aseptic fluid, unite the borders without drainage, and dress the part antiseptically. The patient is kept quiet for two weeks, and a week later may return to business, wearing a suspensory for a month or so thereafter.

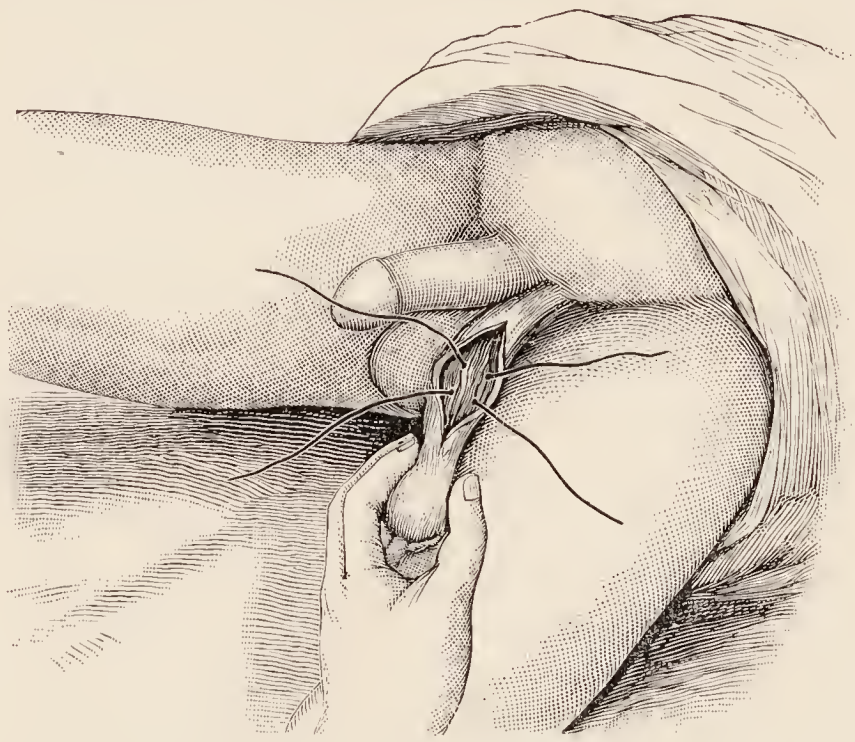


Fig. 1463.—The operation of excision, Howse's method.

**Bennett's Modification of Howse's Method.**—The modification of Bennett contemplates the permanent shortening of the cord by the removal of the connective tissue and muscles, along with the dilated superficial veins. The amount to be removed should correspond to the abnormal lengthening of the cord, as estimated by the comparative pendency of the testicle.

*The Operation.*—Through a free incision expose the fascia that directly surrounds the varicocele; carry around the varicocele outside of this fascia, at an estimated distance apart, two long, strong catgut ligatures; tie the ligatures firmly around the included tissue, and resect it at about a quarter of an inch from the points of constriction; bring the ends of the stumps together, and hold them there by tying to each other the ends of the respective ligatures, supplemented by a catgut stitch or two, if needed; cut the catgut ends short; close the wound without drainage, and dress it as before. The writer has employed this method in several instances with entire success.

*The Precautions.*—In order to avoid impairing the integrity of the testicle, the vas deferens and the artery should not be disturbed in any of the operations, nor should the veins of the vas be treated unless decidedly vari-

cose, which is infrequent. There is danger of transfixion of a vein in the passage of the needle, followed by extensive hæmorrhage into and sloughing of the scrotal tissues. The writer has met with an instance of this kind in his own experience. Thorough antiseptic methods should be practiced in each variety of procedure, to avoid the complications of infection. If the vessels become extensively thrombosed, confinement in bed for a longer time is required.

*The Remarks.*—The operation of free incision with excision is attended with no uncertainty in technique. But the obscurity attending the utilization of pins, ligatures, and wire is objectionable because of the blindness of the procedure. The injection of a few drops of a weak solution of cocain at the seat of puncture will minimize the pain of application of pins and ligatures. The tying of subcutaneous ligatures causes momentarily severe pain, sometimes attended with nausea and faintness. If the patient be caused to stand in a warm room, the veins will soon become distended. Pressure on the cord at the external ring, with the patient in the recumbent posture, is followed by a similar result. Only the superficial veins—pampiniform plexus, as a rule—should be treated. The cremasteric artery is always, and the spermatic artery is often, included in the constriction by the indirect method (Figs. 1451 and 1452).

*The Choice of Operation.*—Subcutaneous ligaturing will be the choice of those who object to the employment of anæsthesia. The writer has practiced Keyes's method frequently, with but one unfavorable result, which has been already mentioned above. Latterly, however, the excision plan has given us entire satisfaction, and possesses the advantage of a definite knowledge of the tissues involved. The difference in the comparative length of the periods of recovery in either instance is not sufficient to exercise a controlling influence in the selection of the plan of action. Notwithstanding the extremely satisfactory results thus far obtained by us in the excision methods, we are not blind to the possibility that gangrene may happen from impaired circulation in the part below. We therefore disturb the tissues during dissection as little as possible, and leave unimpaired two or more of the smaller veins in debilitated subjects and those with unusually pendulous tissues.

*The Results.*—Local septic complications may follow, especially in the absence of requisite antiseptic technique. With proper care, the danger to life from the operation is insignificant. The prognosis for cure is always good, but much better in excision than in the other methods.

**The Repair of the Vas Deferens.**—Division of the vas deferens during operation for hernia, or injury of it from severe contusion of the cord, may call for repair of the damaged structure. The technique of restoration employed in the surgery of the ureter is of equal utility in the repair of the vas deferens (page 856). However, as yet but little has been done in this direction for apparent reasons.

**Elephantiasis of the Scrotum.**—Elephantiasis of this structure is comparatively rare, occurring more often in the colored than in the white race. The growth is commonly a disfigurement, and often becomes so cumber-

some as to impede locomotion. If the cause exist only in the scrotal lymphatics the removal of the mass will effect a cure, otherwise only palliation will be effected. Shock and loss of blood are the especial dangers of operation. However, in the young and in fairly vigorous subjects the outcome is excellent.

*The Preparatory Steps.*—After the requisite general treatment with stimulants, etc., and local antiseptic measures, place the patient on the operating table on the back, and remove him to the place of operation, especially if the tumor be a large one; raise the growth well above the patient and fasten it thus to permit the outflow of the blood and lymph and the return to the abdomen of a complicating hernia; asepticize thoroughly the field of operation and mark out the lines of the proposed incisions—i. e., if possible—where the healthy and diseased tissues meet.

*The Operation.*—Anæsthetize and bring the patient to the edge of the table, placing him in the lithotomy position; control hæmorrhage by passing firmly around the root of the tumor (crossing at the pubis) to the opposite sides of the body the ends of a strong rubber tube, tying them together securely behind the back; cause an assistant to support the tumor in the manner to facilitate the operative steps; pass a long grooved director through the preputial fold upward as far as possible and cause the end to press strongly against the overlying tissues; make a free incision down upon the end of the instrument and push the end through it; divide from above downward along the director the overlying tissues, thus exposing the glans penis; seize the glans with the fingers and free the organ by blunt dissection from contiguous tissues for four or five inches; wrap the penis in antiseptic gauze and draw it aside; make an incision at each side from over the spine of the pubis downward sufficiently to expose the cord down to the testicle; free the testicle and cord from their connections by blunt dissection, wrap them in gauze and carry upward on the abdomen; divide transversely in front the tissues intervening between the incisions at either side; carry (with a long knife) an incision from that made down upon the right cord, downward between the scrotum and perinæum, thence upward at the left side, ending at the incision made upon the left cord; sever with free strokes the tumor from the body, while carefully holding the constricting tube in place; relax the tube, seize and ligature the bleeding points as they appear, cut away the indurated portions, and remove the testicles if hopelessly diseased; arrest oozing with hot, wet compresses; unite the borders of the perineal wound, if conditions will permit, wrapping in the testicles if practicable; surround the penis with gauze saturated with carbolated oil, and dress the remaining raw surfaces in the usual manner; provide a suitable exit for urine, and support the parts along with the superimposed dressings with the common T-bandage, dressing them thereafter as granulating surfaces are treated at other parts of the body.

*The Precautions.*—The surface of the entire mass should be thoroughly cleansed and wrapped in antiseptic dressings before the operation is begun. The rubber constriction tubes should be securely fastened in place by strips of bandage carried upward and fastened before the incisions are made.

Preparations for saline transfusion should be at hand before the operation is commenced. The presence of a hernial protrusion should be determined before amputation is practiced. Urinary discharges should be carefully excluded from the wound throughout the course of repair.

*The Remarks.*—In large tumors the length of the cord is often considerable, rendering the location of the testicle somewhat problematical. If sufficient amount of healthy tissues be at disposal, the penis and testicles should be properly surrounded, otherwise stem grafting may be practiced then or at a later date.

*The Results.*—Only about five per cent die from the operation. The parts usually heal promptly, the penis and testicles being covered with cicatricial tissue if not otherwise better provided. Sometimes the disease returns, usually more or less slowly, the patient remaining comparatively free for a term of years. If the testicles are unaffected their function is not necessarily impaired by the operation and its sequels.

### CONGENITAL MALFORMATION OF THE URETHRA.

The urethra may be absent or occluded; it may be extremely small or bifid; the external opening may be higher or lower than normal, and even double; its walls may be deficient above or below, constituting epispadias and hypospadias respectively. Epispadias is sometimes complicated by separation of the symphysis pubis and exstrophy of the bladder. In many instances these deformities are a great affliction during life, and later often become especially so when the sexual gravity of the deformity is realized.

The operations are performed easier and with better success after the period of infancy, as then the patient is the better controlled and the organ of a larger size. Responsive co-operation is best secured when the patient suffers from the chagrin incident to the appreciation of the importance of the deformity. The preparatory measures in the treatment of these deformities refer more especially to the general fitting of the patient for the purpose and to the requirements of special complications demanding independent action, as exstrophy of the bladder. The preparatory treatment of the individual operations will appear under the proper titles.

**Hypospadias** results from a deficiency in the floor of the urethra. The opening may be in the glans, or in the penile or scrotal portions. The first form is the most frequent and the least important. The scrotal, with and without perineal involvement, is the next in point of frequency, and the most important of all. They may be designated, therefore, as balanic, penile, and scrotal hypospadias respectively. Mixed varieties of this deformity, such as glandulo-penile, peno-scrotal, and perineo-scrotal (page 1244), are sometimes seen.

*The Preparation.*—Before the operation the urine should be drawn and the parts thoroughly cleansed. Chloroform anæsthesia is advisable if no contra-indications to its use be present. The penis is then confined to the strip of wood (Fig. 1464, *p*) by means of the pins passed through the cutaneous borders of the organ, in order that it may be the better controlled during the manipulative measures.

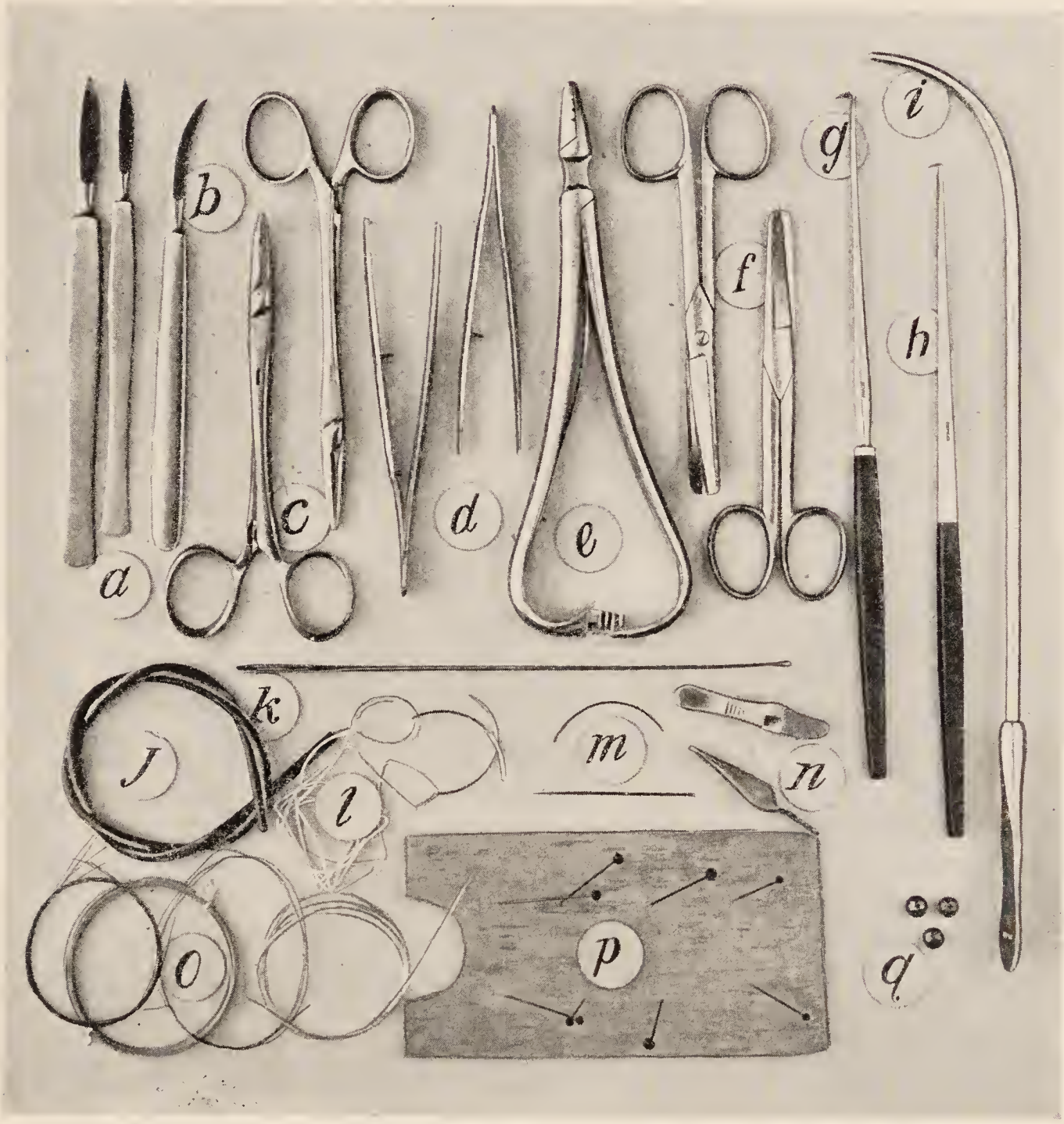



Fig. 1464.—Instruments employed in repair of urethral defects.

*a*. Small scalpels. *b*. Bistoury. *c*. Fine-pointed forcipressure. *d*. Mouse-tooth and dissecting forceps. *e*. Needle-holder. *f*. Short blunt-pointed straight and curved scissors. *g*, *h*. Single and double tenacula. *i*. Steel sound. *j*. Flexible catheter. *k*. Long silver probe. *l*. Traction loops. *m*. Small straight and curved needles. *n*. Langenbeck's clamps. *o*. Horsehair, silkworm gut, and catgut. *p*. Small strip of board and pins, to which the penis is confined during repair. *q*. Perforated shot.

**Gouley's Method** (Fig. 1465).—Gouley's method is especially applicable to the balanic variety.

*The Operation.*—Make two longitudinal cuts at either side of the penis, *a*, *b* and *a*, *b*, far enough apart to leave ample material for the new urethra; make cuts *c*, *d* and *c*, *d*, *a*, *b*, a quarter of an inch outside; remove the integument of the spaces bounded by these incisions; leave undisturbed the skin and mucous membrane included between the incisions *a*, *b*; slide the loose skin at the root of the penis and of the scrotum forward, making the flap double upon itself, until *b*, *b* is brought forward to *a*, *a* and the denuded surfaces at the sides of the penis are brought in accurate apposition with the borders of the reflected flap, making the angle of the fold at *e*, *e*. The first suture is taken at *g*, and passes from within (beneath) outward through the reflected part of the urethral flap, thence from without inward through the

lower and unreflected portion to near the point of starting, thus uniting together near to the point of folding the reflected and unreflected portions of the urethral flap. Before tying, pass the suture of the opposite side in the same manner; tie both, cut the ends short, leaving the knots inside the new urethra; introduce sutures along the external borders, uniting them closely together. The newly formed meatus is transverse, its under lip being the fold of the skin from *f*, formed by the apposition of the points *b*, *b* to *a*, *a*. If curved the organ should first be straightened (page 1237).

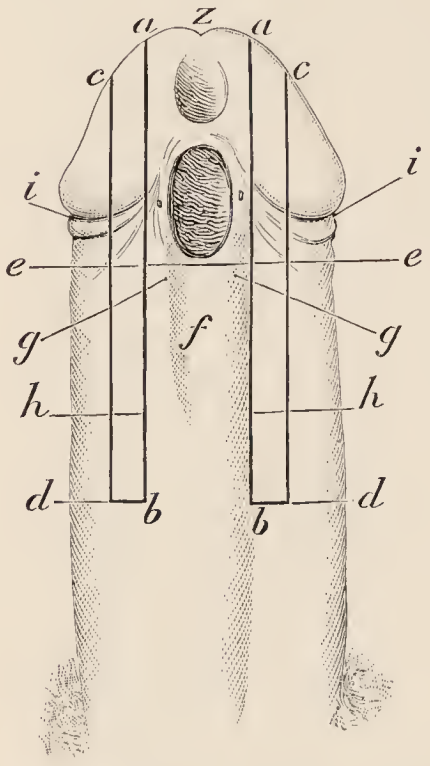



FIG. 1465.—Gouley's method.

**Anger's Method** (Fig. 1466).—Anger's method is a commendable procedure for the repair of deformity at the penile portion only. The general and special preparatory measures of the preceding plan are of equal importance in this one.

*The Operation.*—Make an incision at the left side of the penis, from the glans to the scrotum, *a*, *b*, half an inch from the median line; also incisions at *a*, *c* and *b*, *d*. The flap thus formed, *x*, is dissected up, its base being attached near to the median line, *c*, *d*. A second longitudinal incision, *e*, *f*, is made at the right side of the median line, near to it, and of the same length as *a*, *b*, with lateral incisions an inch and a half long at each extremity, *f*, *g* and *e*, *h* (Fig. 1466). The flaps are raised, a sound introduced into the urethral groove, and the first flap, *x*, turned over it, bringing the integumentary portion in contact with the sound (Fig. 1467). Independent sutures, each armed with a needle, are passed through the free margin of the first flap, *x*, and outward through the base of the second flap, *y*, and fastened by shot pressed around them (Fig. 1468). The remaining flap, *y*, is then placed upon the raw surface of the first, *x*, and fastened to the margin of the first incision, *a*, *b*, in a similar manner or by sutures. The sound or catheter is then removed.

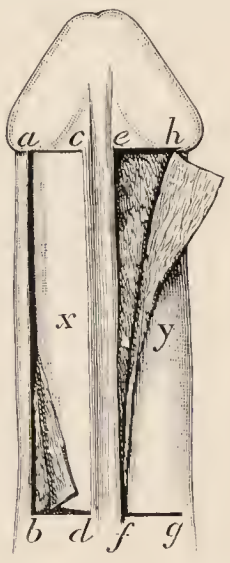



FIG. 1466.—Anger's operation for hypospadias, first step.

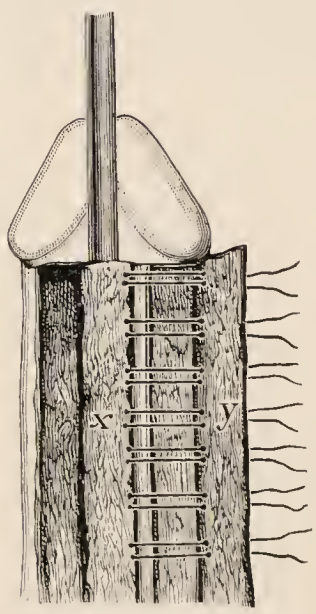



FIG. 1467.—Anger's operation for hypospadias, second step.

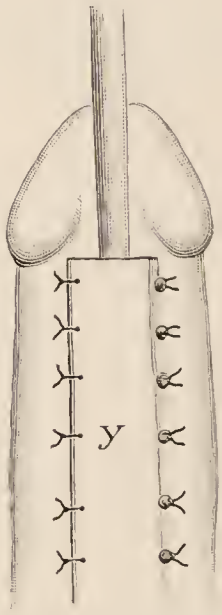



FIG. 1468.—Anger's operation for hypospadias, third step.

**Duplay's Method.**—Duplay's method is divided into three steps. 1. If the penis be incurved, it is straightened and a new meatus made. 2. The

missing portion of the urethra is restored. 3. The old and new parts are joined together.

*The penis is straightened* by making transverse subcutaneous incisions through the restraining bands while the organ is being extended; if the integument be too taut to admit of the proper rectification, it, too, must be severed. The resulting cuts are united in the long axis of the penis, and the penis confined in the corrected position a sufficient time to permit the healing of the wound before the second step of the operation is attempted. It may be necessary to repeat this corrective measure two or three times before the proper position of the organ is gained. At all events, eight or ten months will no doubt elapse before the organ is properly suited for the final step (page 1241).

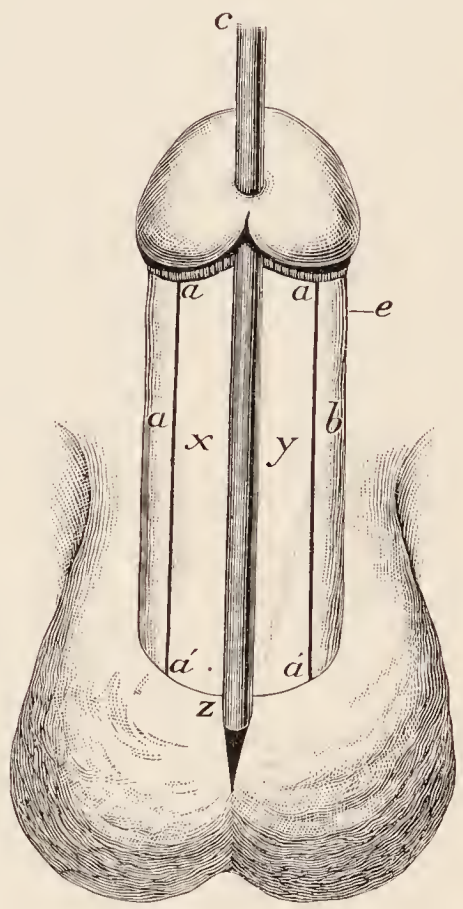



FIG. 1469.—Duplay's method for hypospadias. Forming flaps.

*The first step is completed* by freshening, and, if necessary, deepening the urethral groove at the situation of the proposed meatus, and uniting its raw surfaces with silkworm gut or carbolized silk around a sound or gum catheter, as in Thiersch's method (page 1241).

*The Second Step.*—Pin the penis to the strip of wood (Fig. 1464, *p*) and make two longitudinal incisions, *a*, *a′*, extending from the glans to near the abnormal opening (*z*), one on each side of the urethral groove, at a distance from each other equal to little more than half the circumference of the proposed urethra, a dimension which can be ascertained by measuring the gum catheter over which the flaps are to be reflected. From the ends of each of these a transverse incision is made toward, but not quite to, the median line. The flaps, *x* and *y*, are dissected up and turned inward over a gum catheter, *c* (Fig. 1470), and their margins

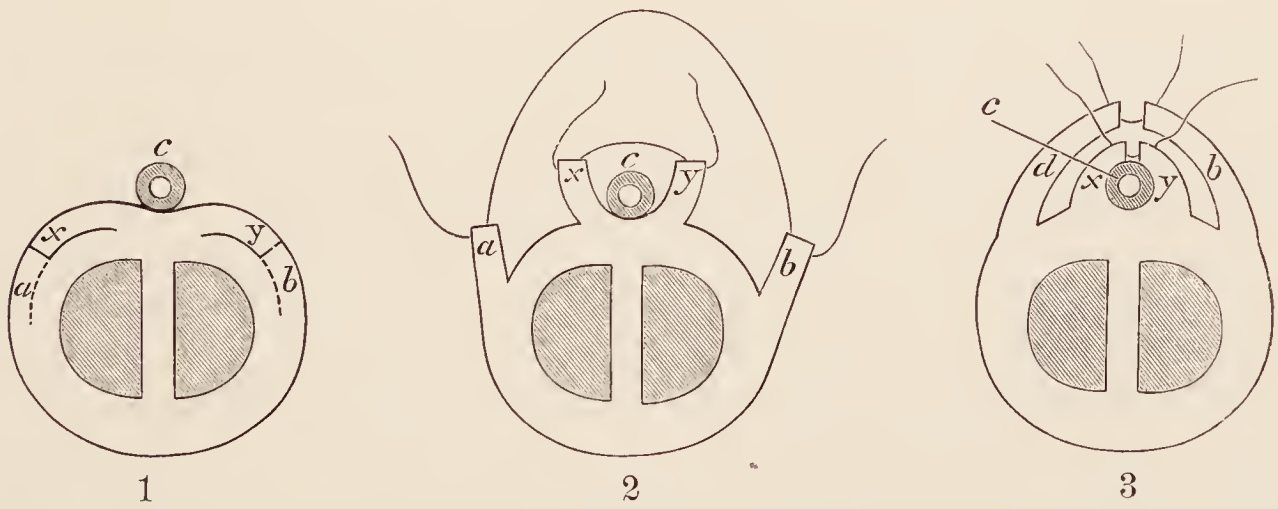



FIG. 1470.—Duplay's method, transverse section. 1. Showing relation of flaps. 2. Flaps reflected. 3. Flaps nearly apposed.

fastened together in the median line by fine catgut sutures (*x*, *y*). The outer flaps, *a* and *b*, of the longitudinal incision are dissected up at the ends and

sides sufficiently to permit them to be easily drawn over the reflected flaps, $x$ and $y$, when they, too, are united in the median line by interrupted or continuous sutures. The quilled suture (Fig. 140), with shot fastening, is admissible for the purpose. Unite the anterior extremities of all the flaps to the raw borders of the glans, thus completing the anterior portion of the tube.

*The Third Step.*—The third step is delayed for three or four months, or at least until the suitable repair of the preceding ones is established. Then the edges of the abnormal opening at the base of the penis ($z$) are freshened and united over a catheter by means of deep quilled and superficial interrupted catgut sutures. In the absence of indications to the contrary, the catheter may be permitted to remain during recovery.

**Szymanowski's Method** (Fig. 1471).—Szymanowski's method is an ingenious and efficient plan of closure of large congenital and acquired urethral defects.

*The Operation.*—Make an incision, $a$, $a$, near the edge of the fistula, extending half an inch beyond it at either end; dissect up from within outward a flap ($x$) bounded by the dotted line; make a curved incision, $b$, $b$, at the

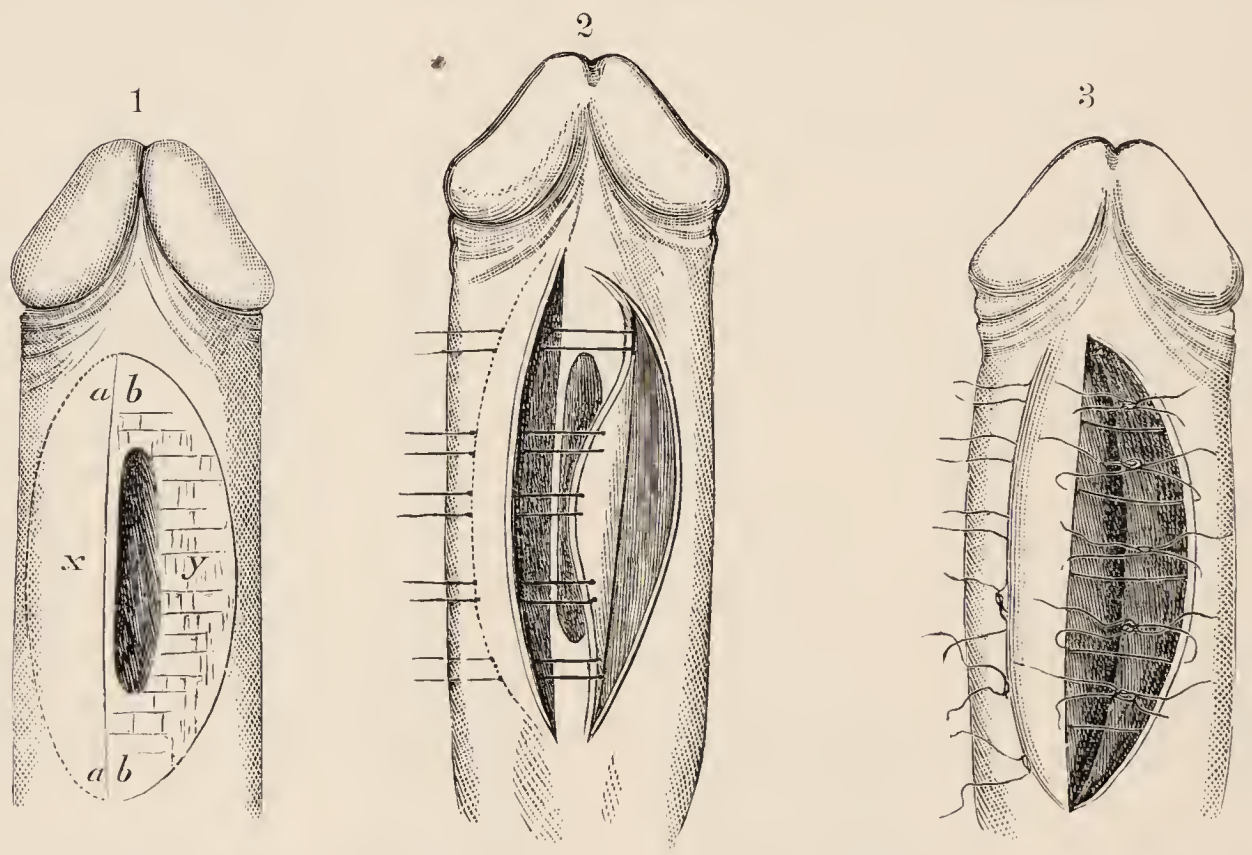



FIG. 1471.—Szymanowski's method of closure of large defects in urethra.

opposite side, its length being a trifle less than that marked by the dotted line of the opposite side, but otherwise of sufficient width to cover the fistula and reach the dotted line when turned upon itself; scrape the cuticle from the flap, $y$, and dissect it up to the edge of the fistula; arm each end of a fine carbolized silk suture with a small curved needle; pass these two needles from the epidermic surface, about a quarter to a sixth of an inch apart, through the edge of the curled flap (Fig. 1471, 2), introducing them from within outward—corresponding to the dotted line—through the base of the flap ($x$) formed by the straight incision; after passing a sufficient number of these sutures—one every quarter inch—draw the curved flap beneath the straight one into the space formed by the separation of the latter, so that its edge will correspond to the dotted curved line (Fig. 1471, 3), and secure the sutures

over a piece of quill or cork, or fasten them with shot. The inner edge of the straight flap is now united to the outer edge of the curved one, and the operation is completed.

*The Remarks.*—The use of the scrotal and preputial tissues for primary reparative flaps is not advisable, unless flaps from other sources are out of the question. The peculiar structure of these tissues interposes an obstacle to prompt healing by reason of œdematous swelling and corrugation. However, when necessary, these tissues can be employed with satisfaction to close small openings directly, or to supplement the use of the more reliable structures. It is wise to correct the penile deformity as early as possible, in order to stimulate its growth to the fullest extent. The buried sutures should be of catgut, the others of silkworm gut or horsehair. The raw surfaces should be accurately apposed, and the sutures not tightly drawn. If the line of apposition be puckered in places, primary union there will fail to take place, and extravasation of urine may occur and small troublesome fistulæ follow. Usually, however, these fistulous openings heal quite readily at a later period with instrumental dilatation of the urethra. After union of the borders of the wound, the organ is dressed lightly with iodoform gauze and carefully supported in the most comfortable position. The application to the borders of a narrow dressing of iodoformized collodion protects them from external infection and holds them steadily in place. But if this dressing contract overmuch, the urinary channel may be narrowed and the escape of urine correspondingly impeded, especially if much swelling takes place. The retention in the bladder of a rubber catheter for two or three days is sometimes practiced with satisfactory outcome. However, the irritation of the instrument and the escape of urine along the side may produce much trouble, and require a prompt withdrawal. The charging of the urethra with sterilized oil at the time of introduction, will do much to lessen and perhaps may obviate these dangers entirely. The writer has practiced the injection of a small amount of sterilized oil into the urethra before each alternate act of micturition, for two or three days, with excellent results. The repeated introduction of the catheter at this time is objectionable, especially if much swelling be present, not only because the advancing end imperils the line of union, but the opposition of the patient may cause tearing asunder of the wound.

*The Results.*—The dangers to life with proper care are insignificant, indeed. The usefulness of the organ is much enhanced if the operation is done as early in life as possible. The general results in older subjects are more disappointing in the final outcome than are those of the younger. Not infrequently a small and even persistent fistula may follow a failure of union at some point, but the repeated use of sounds will frequently assist and also add to the completeness of the cure by increasing the capacity and establishing a uniformity of the diameter of the urethral canal.

**Epispadias.**—Epispadias results from a deficiency in the roof of the urethra. This deformity is less frequent, but more troublesome and difficult to cure than hypospadias. In this also the penis is dwarfed and curved. In some instances the opening into the bladder is exceedingly large and incontinence of urine is present. However, urinary control often results

from operation, even when in other respects it can not be regarded as successful. The ability to secure as satisfactory results in this as in the preceding deformity has not yet been attained.

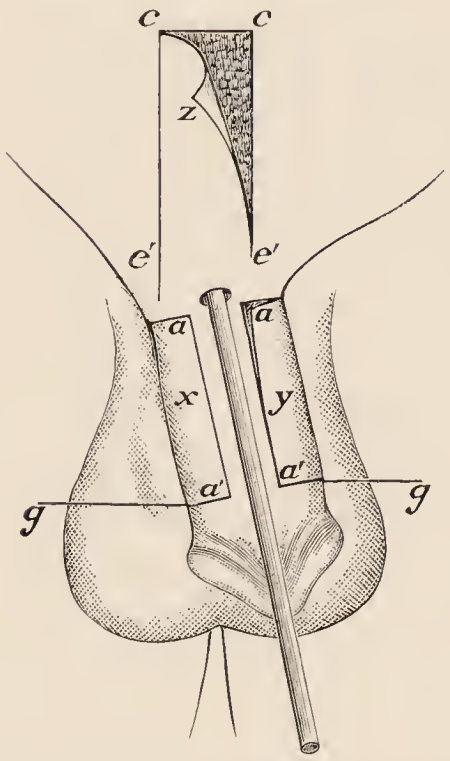



FIG. 1472.—Nélaton's method of operation for epispadias. Formation of abdominal ($z$) and penile flaps ($x$, $y$).

*The general and special preparation* of the patient and the parts, and the attention to details during and after operation, are substantially those employed in hypospadias.

*Nélaton's Method* (Fig. 1472).—Draw the prepuce down over the end of the penis and hold it there with a ligature during operation; adjust the penis to the strip of wood (Fig. 1464, $p$,); pin it in place and make a longitudinal incision along each side of the urethral gutter, $a$, $a'$, at the junction of the skin and mucous membrane, from the corona glandis to the abdominal wall; make a right-angled transverse short outward incision from the ends of each of the longitudinal ones, two or three lines in length; dissect outward from the exterior lip of each incision, $a$, $a'$, to the outer limits of the transverse incisions, forming two flaps, $x$ and $y$; mark out a third flap on the abdominal wall, $z$, by carrying upward from the outer limits of the proximal transverse incision two parallel incisions, $c$, $e'$, connecting them above by a transverse cut; reflect the abdominal flap, $z$, downward so as to form the roof of the new urethra, the cutaneous surface being undermost; unite over a catheter the parallel borders of the abdominal flap, $z$, to the inner borders of the primary incisions, $a$, $a'$, $a$, $a'$ (Fig. 1472); re-enforce the abdominal flap, $z$, by a scrotal one (Fig. 1473, $f$) limited above by a curved incision circumscribing the under half of the organ at the peno-scrotal junction below by an incision, $f$, parallel with the first, located the length of the penis beneath the upper one, and each extremity remaining continuous with the integument of the outer surface, $e$; dissect the flap up, slip the penis under it, and bring the raw surfaces of the flaps ($f$ and $z$) in contact with each other; unite the borders of the scrotal flap to those of the penile flaps, $x$ and $y$, at $g$, $g$, and close the abdominal and scrotal wounds with sutures.

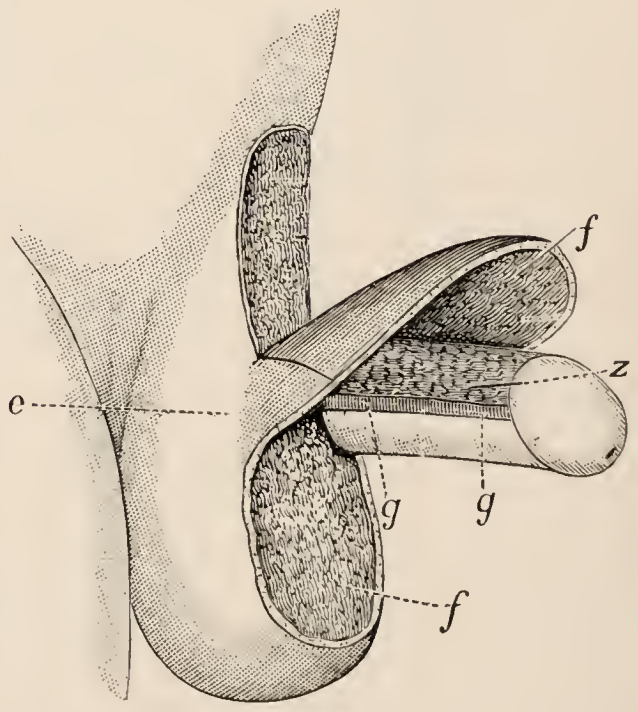



FIG. 1473.—Nélaton's method of operation for epispadias. Formation and application of scrotal flap ($f$).

*The Remarks.*—The hair bulbs of the proposed abdominal flap should be destroyed, and the part allowed to heal before the flap is made, to avoid the subsequent annoyance of the capillary growth. The width of the abdominal flap should exceed somewhat the distance between the penile parallel incisions,

*a*, *a*, in order to establish a capacious urethra. Fine sutures of silk or of chromicized catgut may be employed. If urine escapes by the side of the catheter, or the instrument causes irritation, it should be removed at once, and the case treated as in hypospadias.

*The After-treatment.*—An aseptic and well-oiled catheter is introduced and fastened in the urethra; the parts are dusted with iodoform, and a light gauze dressing is applied from time to time as needed. The bladder should be drained through the catheter, if possible, in the manner already described (page 1114), and the patient and the bedding kept dry. If need be, the sutures are removed in a week or ten days and the catheter at the end of a week.

*The Results.*—With aseptic attention there is no danger to life, prompt and satisfactory healing usually takes place, and thereby the local and general conditions are much improved.

**Thiersch's Method.**—In Thiersch's method a urethra is constructed of more nearly the normal diameter, and the glans penis is covered. This procedure is divided into four stages, and requires often several months for its completion.

*The First Stage* (Figs. 1474, 1475, and 1476).—The first stage relates to the construction of the meatus and the glandular portion of the urethra, and

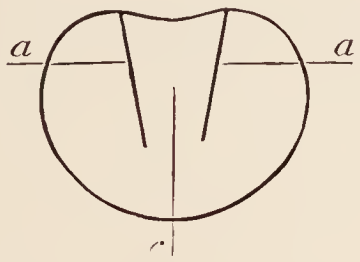



FIG. 1474.—Thiersch's method of operation for epispadias, first stage, transverse section. *a*, *a*. Converging incisions. *c*. Median portion.

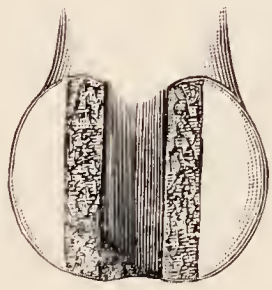


FIG. 1475.—Thiersch's method of operation for epispadias, first stage. Freshening surface of glans.

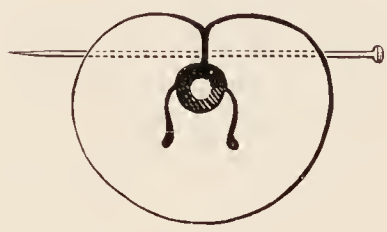


FIG. 1476.—Thiersch's method of operation for epispadias, first stage. Depression of middle portion and union with pin.

is practiced as follows: Make a deep converging incision into the glans, three fourths of its thickness, along each side of the urethral gutter (*a*, *a*, Fig. 1474); freshen a narrow surface of the outer portion of the glans the entire length of the incisions (Fig. 1475); depress the middle portion with a catheter, and unite together around it the lateral portions at their freshened surfaces, holding them in place with fine needles armed with figure-of-eight sutures (Fig. 1476), or with silkworm-gut sutures.

*The Second Stage.*—In the second stage the urethra is constructed. This stage is not begun until the objects of the preceding one are completely attained. Then make an incision through the skin and subcutaneous tissue at the edge of the urethral gutter at the right side (*a*, *a*, Fig. 1477); also a short outward transverse cut from each end, *a*, *b*. Make a second incision on the left side, parallel with the preceding one, half an inch external to the edge of the urethral gutter, *c*, *c*, and a transverse one at each extremity, *c*, *d*, extending inward to the border of the urethral groove. Dissect up flaps *x* and *y* (Fig. 1478), making them as thick as

practicable; raise and turn the flap *y* over a catheter in the urethral gutter so as to form the roof of the new channel, its raw surface being uppermost

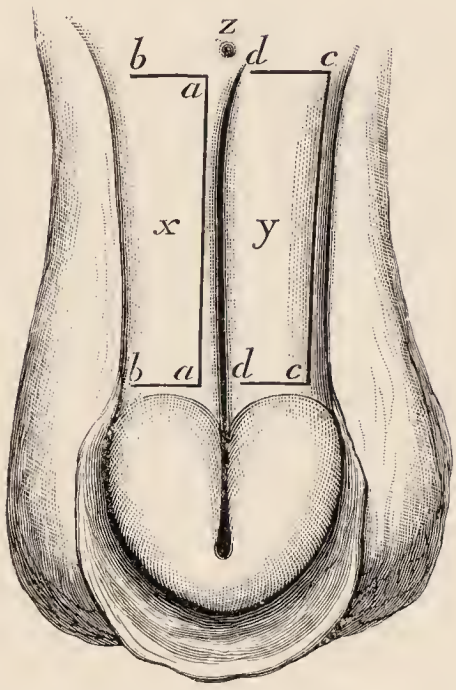



FIG. 1477.—Thiersch's method of operation for epispadias, beginning of second stage. *a*, *a*. Proximal incision. *a*, *b*, *a*, *b*. Short transverse incisions. *c*, *c*. Distal incision. *c*, *d*, *c*, *d*. Short transverse incisions. *x* and *y*. Dorsal flaps. *z*. Fistulous opening.

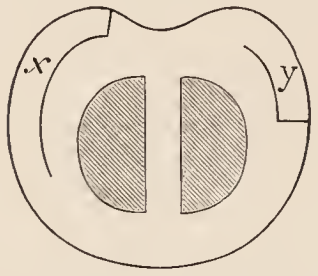



FIG. 1478.—Thiersch's method of operation for epispadias, beginning of second stage. Transverse section, showing formation of flaps *x* and *y*.

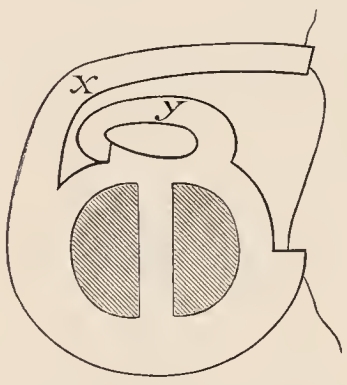



FIG. 1479.—Thiersch's method of operation for epispadias, ending of second stage. Transverse section, flaps reflected.

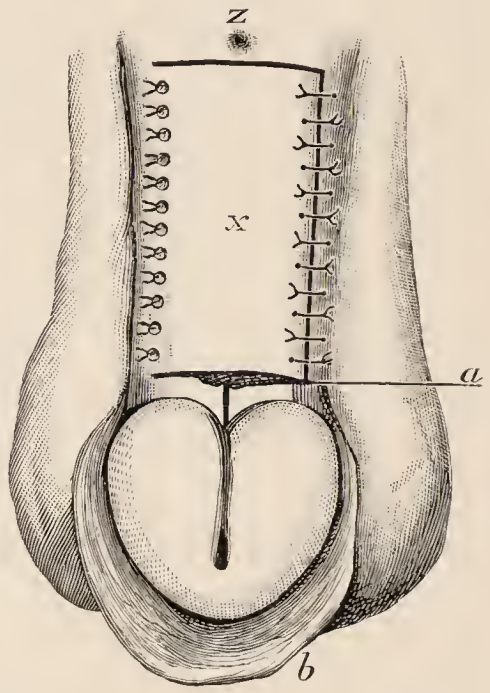



FIG. 1480.—Thiersch's method of operation for epispadias, completion of second stage. *a*. Anterior defect. *b*. Prepuce. *x*. Dorsal flap. *z*. Fistulous opening.

(Fig. 1479). Pass several sutures through it near to its free margin, thence through the inner border of the first incision, *a*, *a* (Fig. 1477), and fasten them by a quill or shot attachment. The flap *x* is then drawn across the former, so that their raw surfaces are in contact throughout, and its free margin, *a*, *a*, joined to the outer side of the incision, *c*, *c*, by sutures (Fig. 1480).

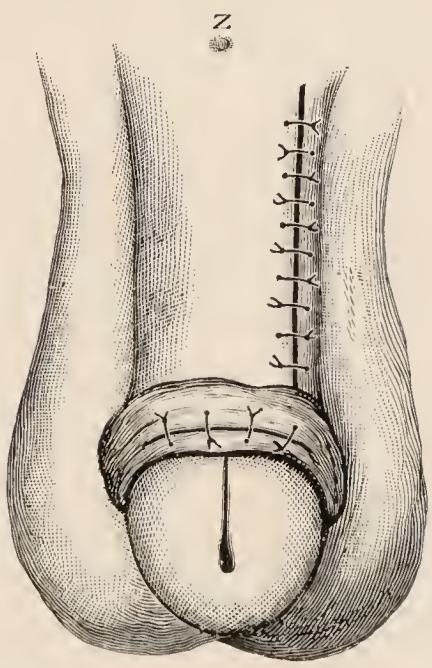



FIG. 1481.—Thiersch's method of operation for epispadias, third stage. Anterior defect closed.

*The Third Stage.*—The third stage consists (Fig. 1481) in closing the small opening located between the glans penis and the roof of the urethra (Fig. 1480, *a*). The prepuce is employed for this object in the following manner: Raise up and buttonhole the pendulous prepuce (*b*) at the lowest part, and press the glans penis through the opening; freshen the margins of the gap on the dorsum, and close it with a flap formed from the reflected prepuce close at hand (Fig. 1481).

*The Fourth Stage.*—The fourth stage is directed to closing the opening into the bladder (Fig. 1480, *z*), which is done by means of two flaps—right and left (Fig. 1482, *a*, *b*). The left (*b*) is taken from the left groin, is triangular in shape, with the

base located at the left upper half of the opening, and, when turned downward with the raw surface uppermost, forms the roof of the opening (Fig. 1482). Its margins are sewed to the freshened upper border of the new roof of the urethra (Fig. 1483). The right flap (*a*) is longer, and the base is located at the right external abdominal ring. Its raw surface is placed in contact with that of its fellow, and fastened in place with sutures (Fig. 1483) addressed to the contiguous borders. The remaining raw surface (*c*) is permitted to heal by granulation, or repaired by skin grafting.

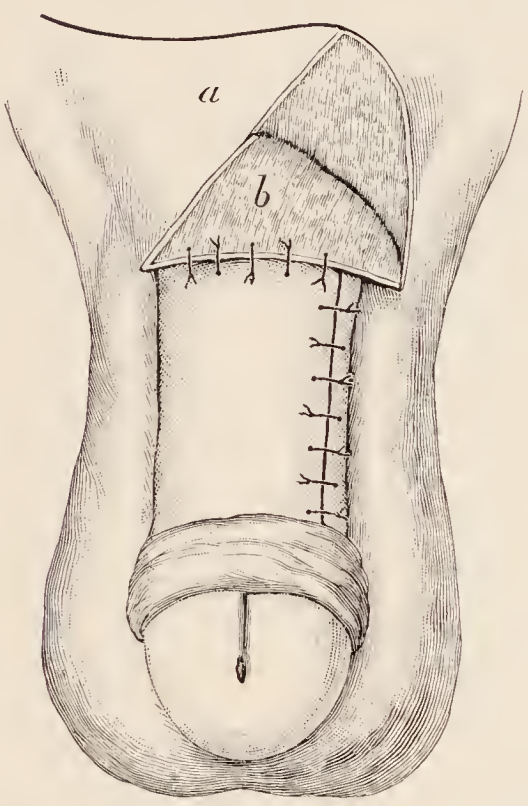



Fig. 1482.—Thiersch's method of operation for epispadias, fourth stage. Closure of fistulous opening.

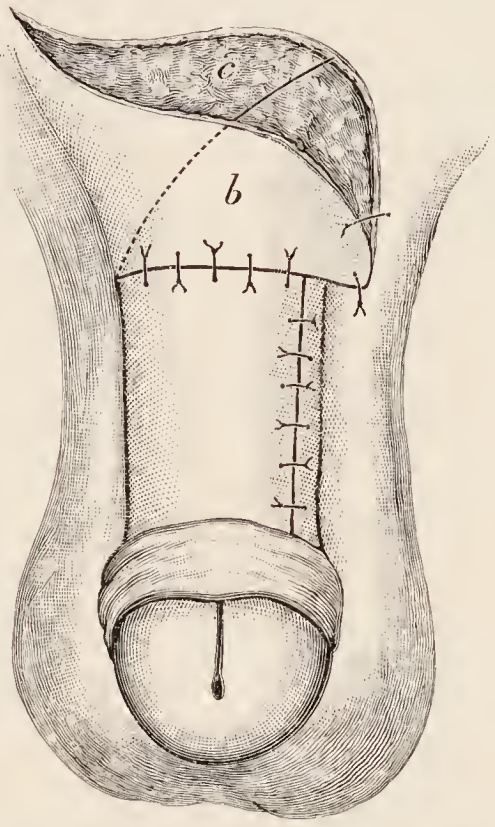



Fig. 1483.—Thiersch's method of operation for epispadias. Completion of fourth stage.

*The Remarks.*—A proper interval should elapse between each stage of the operation, to allow of complete repair of the preceding steps and a suitable estimate of their success. Formerly Thiersch established a temporary perineal fistula, but he has since decided that with proper care it need not be made.

**Duplay's Method.**—In Duplay's, as in the preceding method, the operation is divided into four stages:

*The first stage* is allotted to the straightening of the penis, which is done in the manner already described (page 1237).

*The Second Stage.*—In the second stage the urethra is formed and entirely (Fig. 1484) from the central, *x*, *x*, penile structures.

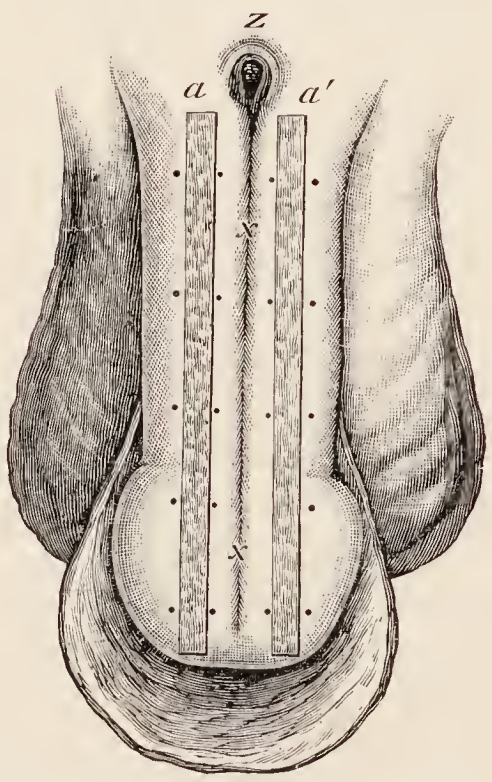



Fig. 1484.—Duplay's method of operation for epispadias, second stage. *a*, *a'*. Freshened surfaces. *z*. Fistulous opening.

A strip of tissue about a quarter of an inch in width is freshened at each side of the urethral gutter (*a*, *a'*), and the freshened surfaces are united with

each other over a catheter by means of quilled sutures (Fig. 1485). However, if the urethral groove be shallow at the outset, a median incision (*a*) is made along its whole length to facilitate easier adjustment of the freshened surfaces.

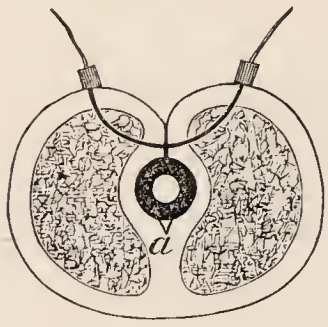



FIG. 1485.—Duplay's method of operation for treatment of epispadias, completion of second stage. *a*. Median incision.

*The Third Stage.*—In the third stage the prepuce is treated as in Thiersch's method, and so arranged on the dorsum of the organ as to provide a sound cutaneous covering for as much of its distal part as is possible.

*The Fourth Stage.*—The fourth stage is devoted to the closure of the opening into the bladder. The surfaces of the apposed borders of the gap are freshened and united and held in place by shotted sutures.

*The Remarks.*—The same aseptic care is exercised in this as in the preceding methods. If permissible, the catheter is allowed to remain in the canal with the end in the bladder until the wound is safely healed. The writer has practiced Thiersch's method repeatedly, and in each instance with entire success. In no case was a temporary perineal fistula made.

**Perineal Hypospadias** (*perineo-scrotal*).—This form of hypospadias is the rarest of all of these defects, and the deformity is great and the prospects of success of operative effort more uncertain and protracted than in either of the preceding instances. The conditions of the penis are variable, and often complicating, the organ sometimes being unusually atrophied, strongly incurved, and affixed to the scrotal fissure, thus obscuring the urinary opening. *The operative treatment* relates to remedying the penile portion of the deformity by the stated method suited to the purpose, followed with closure of the perineal defect by direct union or by proper flap procedures.

### ACQUIRED URETHRAL DEFECTS.

The walls of the urethra may suffer loss of substance, producing a fistula. The caliber of the canal may be diminished, causing stricture, either of which usually depends upon acquired causes.

Before attempting an operation for the closure of a urethral fistula the caliber of the canal should be made as near to its normal size as possible by appropriate treatment of the strictures and such other obstructions as may exist in its course.

**Urethrorrhaphy.**—Urethrorrhaphy is employed to close a small urethral fistula not exceeding a fifth of an inch in diameter, if it be circular, and one fourth if longitudinal. If reasonable success is to be attained, it is necessary that careful attention be paid to every aseptic detail.

Before beginning the operation empty the bladder, and, if necessary, administer an anæsthetic. Local anæsthesia will commonly suffice.

*The Operation.*—A sound is introduced into the urethra, and the handle given in charge of an assistant. The edges of the opening are carefully pared obliquely from without inward, and, when completed, should present a funnel-shaped appearance, the apex corresponding to the mucous opening of the canal; undercutting is then done, dividing the tissues into two sepa-

rate planes (Fig. 1486). The wound is then closed longitudinally by uniting each layer separately (Fig. 1487), the former with catgut, the latter with horsehair, silkworm gut, or silk (Fig. 1488). Closure without undercutting, by means of silkworm gut, horsehair, or antiseptic silk sutures carried down to, but not through, the mucous lining, the intervals between them being short, may be made (Figs. 1489 and 1490).



Fig. 1486.—Urethrorrhaphy. Tissues undercut, separated, and prepared for sewing.

*The After-treatment.*—The patient should be kept quiet and given alkaline and demulcent drinks, and the urine drawn with a catheter. It is a wise precaution to inject aseptic oil into the urethra before the introduction of the catheter. The catheter may be introduced before the sewing, and allowed to remain as a guide to the latter, and for the escape of urine thereafter, as long as advisable.



Fig. 1487.—Urethrorrhaphy. Deep layer of tissue united, shown transversely and longitudinally.

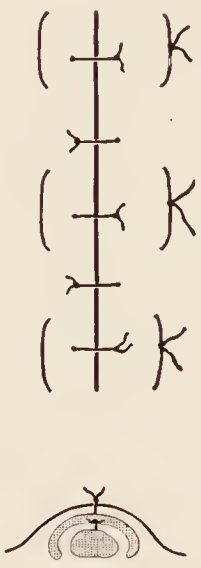


Fig. 1488.—Urethrorrhaphy. Deep and superficial tissues closed, shown transversely and longitudinally.

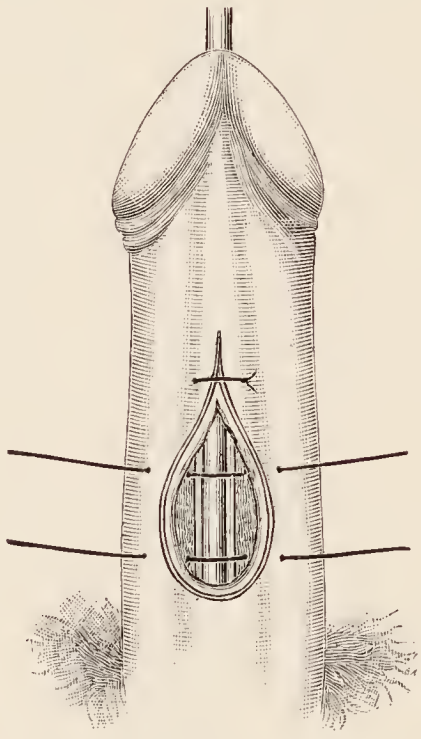


Fig. 1489.—Closing large urethral fistula. Oval freshening.

*The Comments.*—The ill effects of the contact of urine with the freshened borders of the opening emphasizes the wisdom of the establishment of perineal drainage during the healing, unless especially contra-indicated. However, in some cases, the catheter can be borne by the urethra long enough to allow the wound to heal, thus avoiding the perineal element of the case. If the catheter be well borne, its use may be supplemented by a rubber tube extending from it to a vessel beneath the bed.

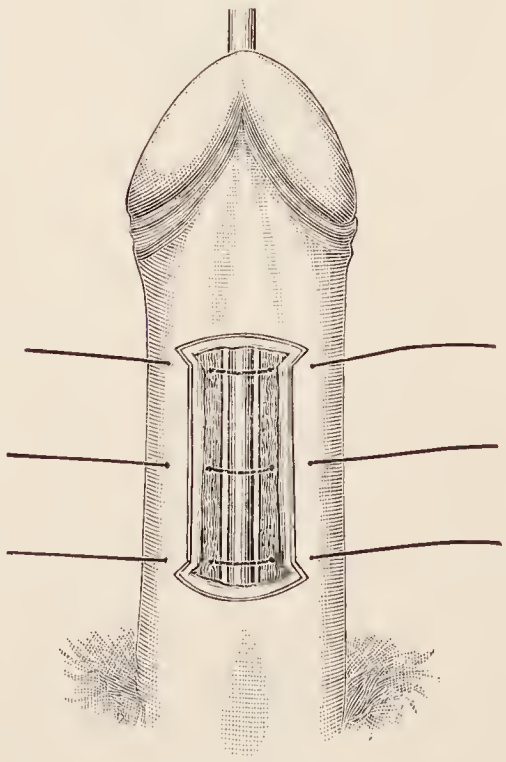


Fig. 1490.—Closing large urethral fistula. Freshened borders and lateral flaps.

**Urethroplasty.**—Urethroplasty is employed to close larger openings than those within the domain of urethrorrhaphy.

If flaps be dissected upon either side of the opening, and drawn together and joined in the

median line, imperfect union is very apt to result on account of their thinness, median contact, and from sluggish granulation process.

**Nélaton's Method** (Fig. 1491).—In Nélaton's method the edges of the opening are first pared, and then the integument is detached subcutaneously for about an inch around it by entering a long, thin knife blade through a transverse cut just below the opening. The liberated integument is then joined in a longitudinal fold along the median line by means of quilted sutures.

*Dieffenbach* (Fig. 1492), instead of dissecting subcutaneously, raised two parallel longitudinal flaps, and fastened the middle of their raw under surfaces together by sutures passed through leather supports at each side. Two or three rows of sutures can be used instead of this method of apposition.

*Delpech* dissected up a single flap, drew it across the fistula, and fastened it to a raw surface prepared on the opposite side. *Arlaud* made two transverse flaps, one in front and the other behind the fistula, about an inch and a half in width. The anterior one was dissected up toward the glans about three fourths of an inch, and the posterior one back over the scrotum, until it could be easily drawn forward so as to cover the fistula. The cutaneous surface of the anterior portion of the scrotal flap was freshened and the flap drawn forward so as to cover the fistula, and the anterior flap drawn backward over it and united by sutures.

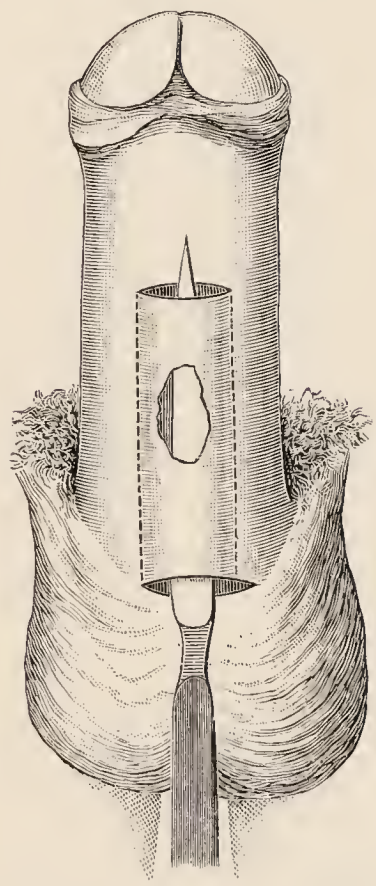


FIG. 1491.—Urethroplasty, Nélaton's method.

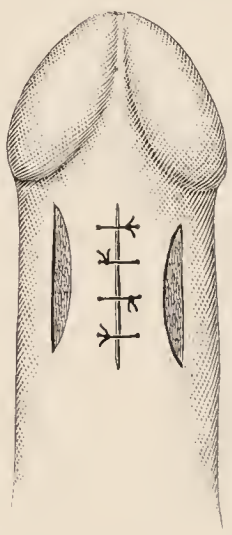


FIG. 1492.—Urethroplasty, Dieffenbach's method.

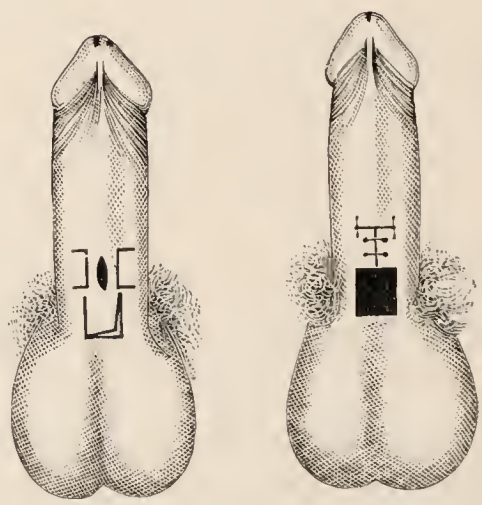


FIG. 1493.—Urethroplasty, Rigaud's method.

*Rigaud* (Fig. 1493) closed a large fistula at the peno-scrotal junction by the method employed by Nélaton in the treatment of epispadias. A quadrilateral median flap, with its base adjoining the opening, was taken from the scrotum, turned forward over the fistula, and its raw surface covered by two flaps taken from the sides and drawn together so as to meet in the median line.

**Dittel's Method** (*by flap sliding*).—According to Dittel, when the fistula lies in the neighborhood of the scrotum, it is easy to draw the scrotal skin over it. But, should the posterior angle of the coapted surfaces be exposed to urinary infiltration, it would be better to employ a skin flap which has been liberated from the subcutaneous tissues.

*The operation* is performed as follows: A large metal sound is introduced, putting the urethra and fistula opening on the stretch. The scar tissue around the fistula is trimmed away, so that the resulting freshened surface has an oblong shape, its long diameter lying transversely to the long axis of the penis. An incision parallel with the posterior margin of the wound is now made through the scrotal skin, which is distant from the fistula one to one and a half inch, according to the size of the denuded area. The flap thus outlined is dissected up from the subcutaneous tissues, forming a transverse bridge of skin which is slid forward over the area to be covered. The anterior margin of the bridge is joined to the anterior margin of this area by means of button sutures. The posterior slit is left open, or is used in so far as to introduce a soft, thin catheter for the purpose of raising the hinder margin of the bridge and protecting the wound from urinary infiltration. After the flap has united anteriorly, the posterior slit is freshened up and its edges united in a manner similar to that already described.

**Operation by Flap Transplantation.**—In refreshening the edges of the fistula in this operation, a long oval shape is given to the denuded area. A flap, the size of which somewhat exceeds that of the area to be covered, is formed from the scrotal integument, its base situated either quite at the posterior end, or else near one side of the refreshed oval surface. In the former instance the flap is swung around on its pedicle, as is a flap from the skin of the forehead in rhinoplasty. In the latter, the flap is exposed to a moderate tension. The flap is sewed in position by means of button sutures. After union has taken place at its free extremity a secondary operation is performed for closure of the opening at the base of the flap, and for the proper treatment of the pedicle.

**Urethrostomy.**—*Poncet* exposes an incurable stricture through a median incision in the usual manner, divides the urethra transversely at the proximal side of the constriction, slits the under surface of the central stump for a short distance, and stitches it to the lower angle of the cutaneous wound. The end of the peripheral urethral stump is sutured, dropped into the wound, which is then closed and stitched down to the perineal opening.

**Perineal Urethroplasty.**—Perineal urethroplasty has been practiced in the repair of the gap in the urethra following urethrectomy for extreme stricture and for partial or complete rupture of the urethra. *Wölfler* removed the cicatricial area of a strictured urethra, and covered the granulating surface with mucous membrane taken from a prolapsed uterus, the same as Thiersch's skin grafts are applied. The tissue was kept in place with lubricated iodoform gauze. Several successful results of this nature are reported. *Keyes* secured a partial success by grafting the inner layer of the prepuce. In not a few instances, when due to rupture (page 1253) or excision of a stricture, the urethra has been repaired by the union of the divided ends over a catheter with catgut or silk sutures (Figs. 1502 and 1503). *Weir* reports two such cases as successful with silk sutures and suprapubic drainage in urethral rupture. *Robson* reports a success in a case of urethrectomy for stricture by continuous catgut sewing of the divided extremities over a catheter.

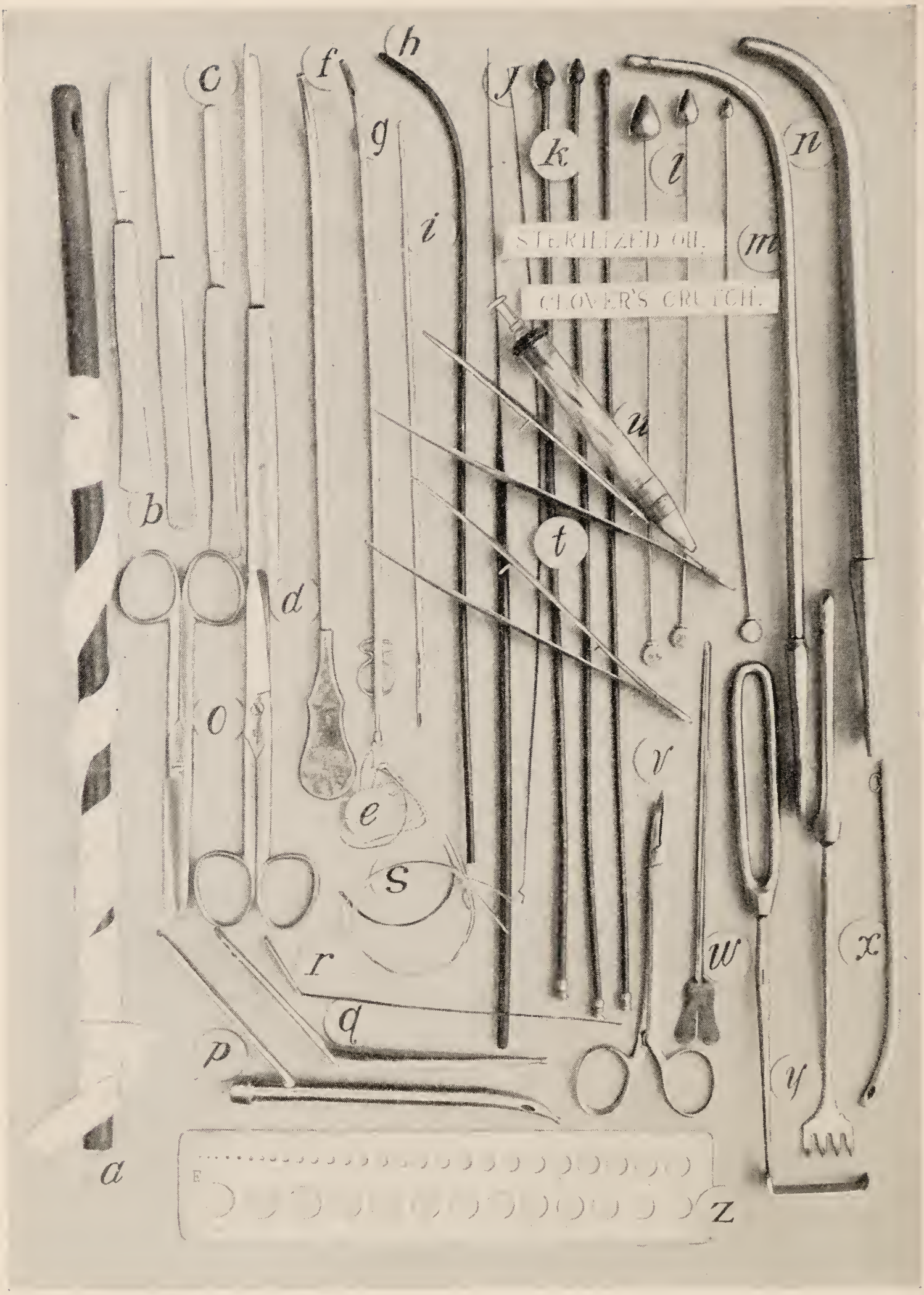



Fig. 1494.—Instruments employed in perineal section and conditions requiring it.

*a*. Perineal drainage tube with tapes. *b*. Bistouries, straight and blunt. *c*. Bistoury, blunt-pointed. *d*. Blizard's lithotomy knife. *e*. Traction loops. *f*. Tunneled staff. *g*. Tunneled catheter and stylet. *h*. Small gum catheter. *i*. Long silver probe. *j*. Banks's whalebone dilator and a whalebone guide. *k*. Flexible, gum, bulbous bougies, assorted sizes. *l*. Otis's metallic bulbous bougies, assorted sizes. *m*. Grooved staff. *n*. Steel sound. *o*. Scissors, short blunt-pointed, straight and curved. *p*. Brown's flushing director. *q*. Teale's gorget. *r*. Arnot's fine director. *s*. Large curved needle and silkworm gut. *t*. Thumb and mouse-tooth forceps. *u*. Glass penis syringe. *v*. Forcipressure. *w*. Grooved director. *x*. Female catheter. *y*. Blunt and hooked retractors. *z*. Scale for determining size of bougies and sounds. Wipers, ligatures, and gauze should be provided.

*The General Remarks.*—After these operations the urine should be kept bland by a free use of diluents and other corrective remedies. The parts should be kept thoroughly cleansed and free from misdirected handling. Incurving is due in part to shortening of the capsule of the corpora cavernosa and perhaps of the fibrous septum, and considerable time—five or six months—may pass before the tendency to return of this deformity disappears. The muco-cutaneous ridge corresponding to the absent urethra must be divided transversely in a subcutaneous or open manner. *Duplay* commends the latter, advising that they be carried to some depth and the borders united longitudinally, thus overcoming the curvature.



Fig. 1495.—Syme's grooved staff.

**External perineal urethrotomy** (Gouley), sometimes called *perineal section*, is employed in the treatment of intractable strictures, especially when accompanied by a urethral fistula located in the perinæum and for rupture of the urethra. External perineal urethrotomy may be performed either *with* or *without a guide* and under thorough asepsis. The former is not a difficult operation, while the latter is frequently an extremely perplexing one. Syme's grooved staff (Fig. 1495) is objectionable, in that its point may get into a false passage and the stricture be missed. Moreover, its introduction through the stricture is more difficult than that of the whalebone guide, and is attended by greater danger to the soft parts. If the ordinary small-sized grooved staff employed in lithotomy can be introduced, nothing better than this need be desired.

*The Operation with a Guide* (for Stricture).—Evacuate the bowel, shave and cleanse the perinæum, administer an anæsthetic, disinfect and fill the urethra with aseptic olive oil, locate the seat of the stricture, and introduce a whalebone guide into the bladder in the manner before described (page 420); over this pass the grooved or tunneled catheter staff down to and through the stricture (Fig. 1307), if it can be done readily; if not, allow its beak to rest against the obstruction, the instrument being carefully supported by an assistant, who at the same time raises and holds the scrotum. The patient is now placed in a lithotomy position, and the limbs supported by an assistant upon either side. The surgeon, sitting upon a low stool facing the perinæum of the patient, introduces the left index finger into the rectum to ascertain the condition of the membranous and prostatic portions of the canal. A free incision, from an inch to an inch and a half long, is then made in the median line of the perinæum, extending from the base of the scrotum to within half an inch of the anus, through the integument and fascia. The grooved instrument is carefully located by

the finger, and the urethra brought into view by repeated cuts in the same line. The nail of the index finger assures the surgeon of the location of the groove, and the urethra is divided longitudinally upon it. Two silk traction loops are now passed, one through each border of the divided urethra, and are given in charge of assistants, who are instructed to carefully draw the lips of the wound apart (Fig. 1496). This important step exposes the mucous wall of the urethra completely, enabling the operator to follow its course by carefully observing the continuity of its structures. The staff is now withdrawn sufficiently to expose the black whalebone guide, then the beaked bistoury (Fig. 1498) is introduced in its course, and the stricture, together with about half an inch of the canal immediately behind it, is divided in the median line.

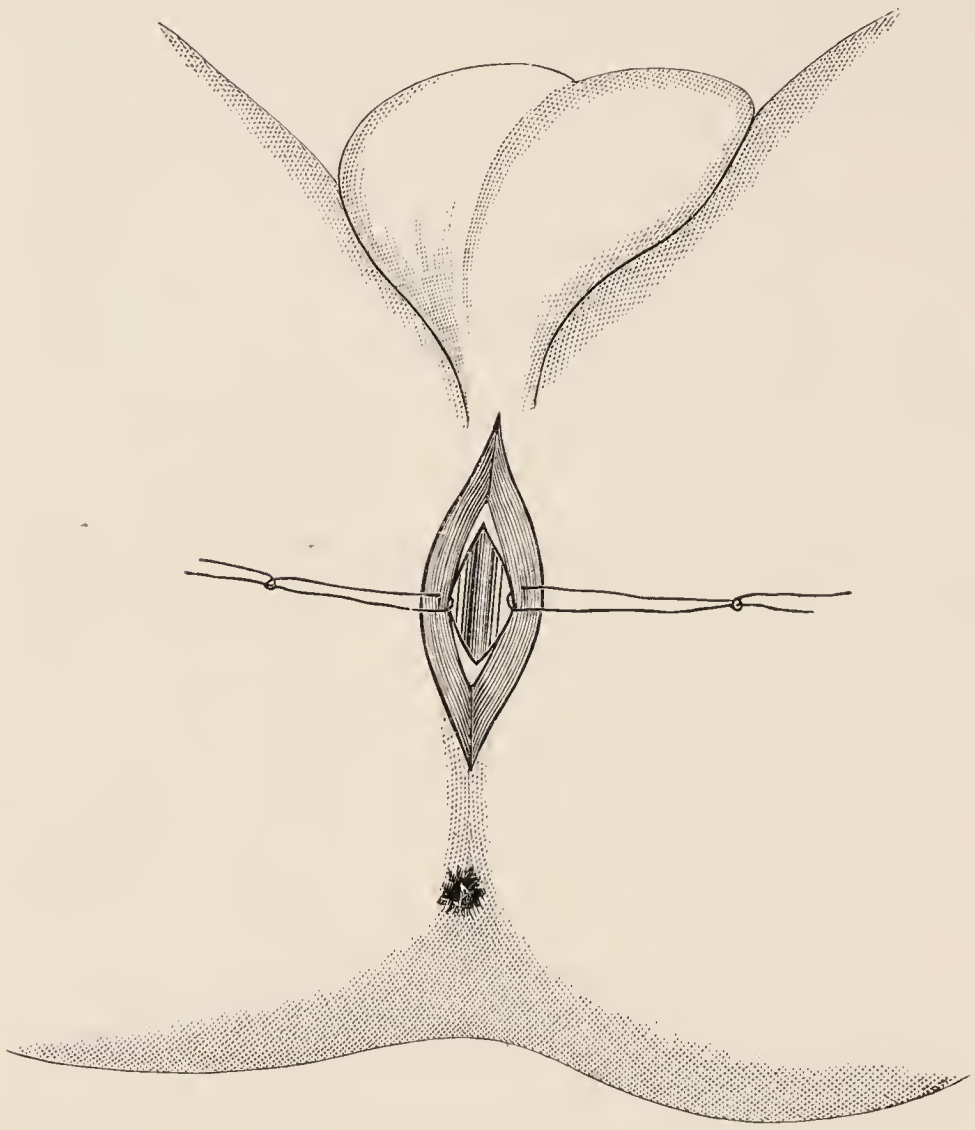


Fig. 1496.—The operation of external perineal urethrotomy. Grooved staff seen between separated borders of incisions.

The entrance of a grooved director or a small gum catheter through the opening into the bladder, followed by the flow of urine, assures the surgeon that the proper channel is located; or, after the division of the stricture, the tunneled catheter (Fig. 1307) may be passed along the whalebone guide into the bladder, and the stylet withdrawn, when the diagnostic urinary stream will appear. The instruments are now withdrawn from the urethra, and the ordinary sound of suitable size is introduced through the urethra into the neck of the bladder, to determine the complete freedom of the passage.

*The Remarks.*—The passage of bulbous bougies (Figs. 1494 and 1507), with the object of determining the number,

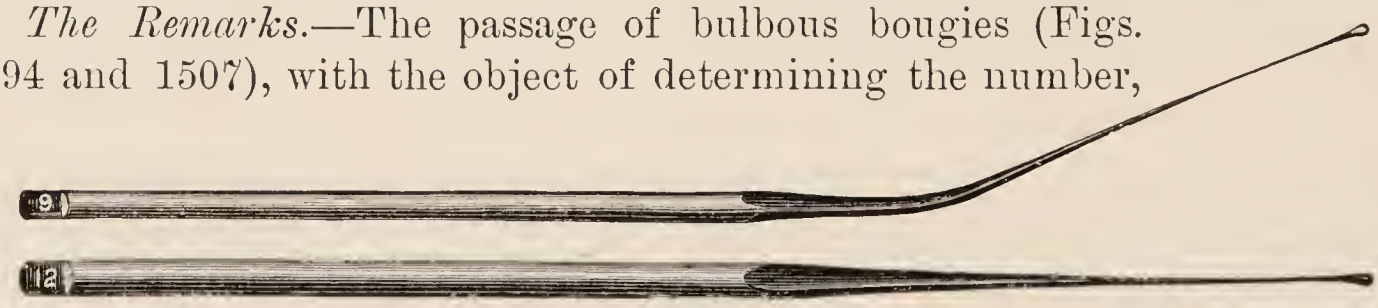


Fig. 1497.—Banks's dilating filiform bougies.

location, size, and resiliency of the strictures (page 1255), should be practiced, thus establishing the need of a more active operative treatment than

that by the use of sounds. The whalebone filiform bougies of Banks (Figs. 1497 and 1507) are so shaped above as to readily overcome a stricture through which the advancing end has already passed far enough for the purpose. However, great care should be exercised in their use, or harmful results will quite surely follow. The beaked bistoury of Gouley (Fig. 1498), the grooved director (Fig. 1499, *c*), and small sharp tenaculum (Fig. 1499, *e*), are of special aid in this operation. Sometimes a small invaginated catheter (Fig. 1500) will find a way along devious channels of suitable dimensions that can not otherwise be traveled. This agent is of much greater utility in connection with retention of urine from prostatic enlargement (page 1114) than when associated with perplexing false passages. It is evident at once that the invaginated catheter will, after its escape, point a different course than that of the external one, and therefore gain prompter admission to the bladder.



Fig. 1498.—Gouley's beaked bistoury.

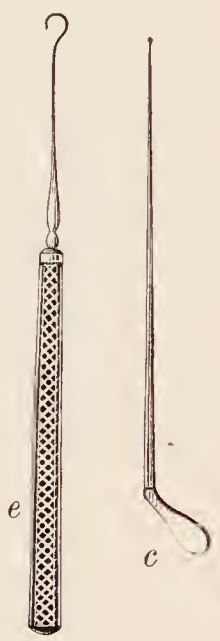



Fig. 1499.—Gouley's grooved director (*c*) and tenaculum (*e*).

*The Operation without a Guide.*—After all efforts to introduce a whalebone guide (Fig. 1501) into the bladder have failed, pass the tunneled catheter staff (Figs. 1304, *k*, and 1309) over a whalebone guide along the urethra as far as it will go without using violence; then place the staff and guide in charge of an assistant as before. Make an incision of the usual length directly in the median line down to and through the urethra into the groove at the end of the staff; pass the silken loops through the borders of the incised urethra as before (Fig. 1496); check all hæmorrhage, withdraw the staff slightly, and examine to see if it be located in the urethral tube. The lips of the urethral incision are now drawn well apart, and the operator, whose patience, care, and knowledge must now be well tested, endeavors to introduce a whalebone guide, or a fine probe, or a small grooved director (Fig. 1499, *c*) through the stricture

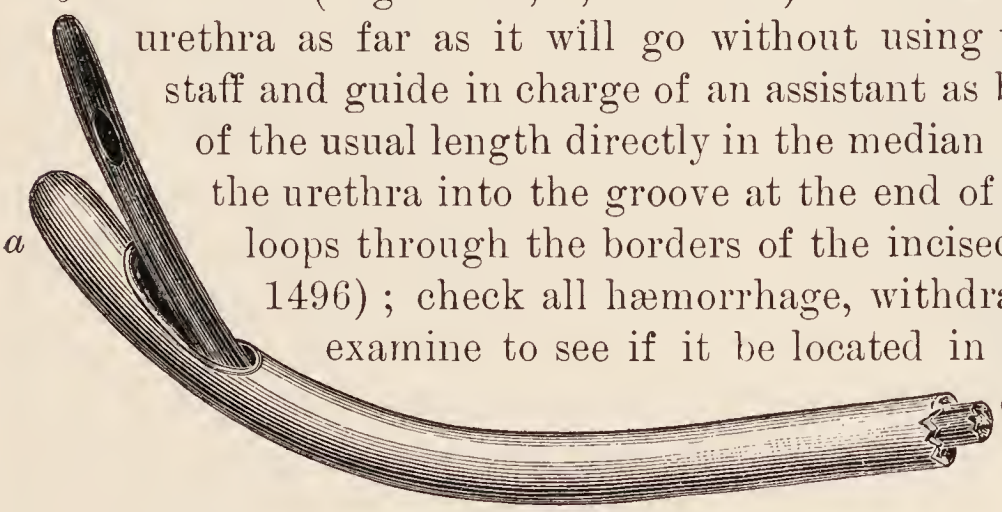



Fig. 1500.—Mercier's invaginated catheter.
*a*. Retaining catheter. *b*, *b*. Invaginated catheter

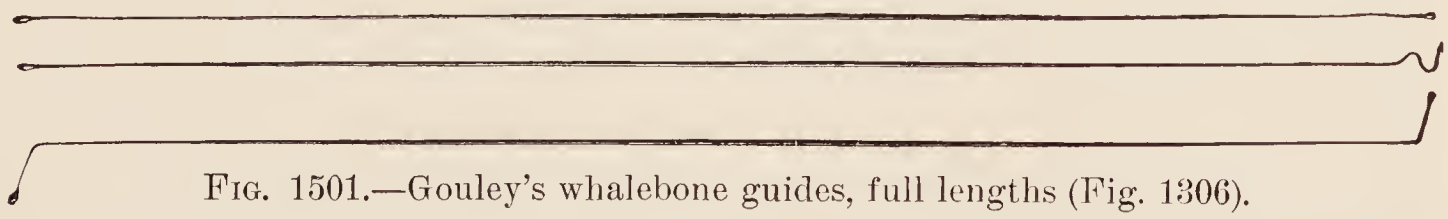


Fig. 1501.—Gouley's whalebone guides, full lengths (Fig. 1306).

into the bladder by way of the perineal incision. If the effort be successful the remainder of the operation is simple, and consists only in dividing the

stricture with the beaked (Fig. 1498) or a probe-pointed bistoury from above downward as before; usually, however, no anterior opening can be found, or one may be detected which leads away from the median line, showing the existence of a false passage.



Fig. 1502.—Incomplete rupture of urethra with catheter in the canal preparatory to sewing.

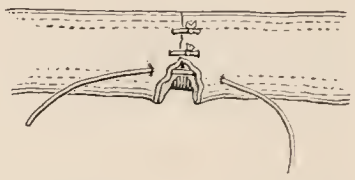


Fig. 1503.—Incomplete rupture of urethra being sutured over catheter.

In either case the plan of the operator must be the same. Keep in the median line. If, after a patient search, no direct orifice be found, it is often possible to detect it by making moderate pressure above the pubes on the bladder, which will frequently cause a few drops of urine to escape from the obscure opening in the perineal cut, into which a whalebone guide or a fine director can be inserted, and usually passed into the bladder. Hot-water injection into the wound will sometimes reveal the urethra by emphasizing its paler color. If nothing is accomplished by either of these, then the surgeon feels for the opening in the triangular ligament (Fig. 1379), through which the urethra normally passes, and cuts toward, and even through it if the urethra can not be found before. As he cuts he repeatedly seeks for the orifice, and closely examines for a continuity of the fibrous mass in the line of his incision with the tissues composing the walls of the urethra. In the obscure division of the amalgamated perineal tissues the surgeon is also guided by the established relations of the normal urethra to the arch and rami of the pubes, to the tuberosities and rami of the ischium (Fig. 1378 and page 1182), and, still more important, the relations to the rectum. The careful cutting and searching are continued until an opening is found which leads into the bladder. The tissue barring the passage is cut, and a small gum catheter is passed along the probe or director into the organ. This act is followed by the welcome flow of urine. The catheter is then withdrawn, the canal dilated gently, and all constricting bands at the roof and floor of the urethra are severed. A steel sound the size of the canal is then intro-

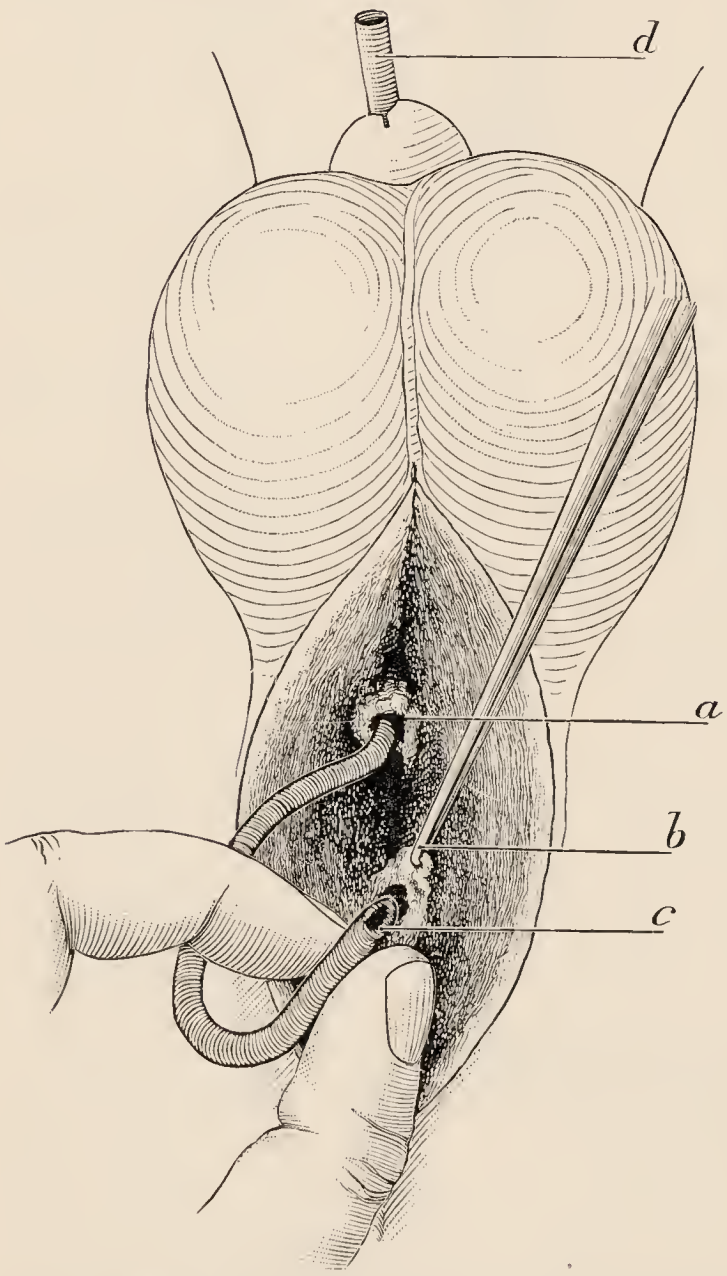



Fig. 1504.—Complete rupture of urethra, proximal end found. Introduction of catheter preparatory to sewing. *a*. Distal end of rupture. *b*. Proximal end of rupture held open by forceps for introduction of catheter (*c*). *d*. Catheter introduced into urethra.

duced into the bladder through the urethra until its uninterrupted entrance is assured. The size of the meatus is increased, and all obstinate strictures in front of the perineal opening divided by internal urethrotomy. Examine the bladder for stone, and if found remove it; stop all bleeding.

*In rupture of the urethra*, occasionally a catheter or staff may be passed quite readily into the bladder. But in instances of complete rupture from bruising of the perinæum, or incomplete rupture complicated with narrow stricture, this measure can not be accomplished at once, if at all, especially in a case of the former condition. In rupture from bruising, a free incision into the perinæum is made in the median line down upon the convexity of a grooved staff (page 1192), if introduced into the bladder; if not, upon the advanced end, thus exposing the seat of the injury and permitting of the elimination of the blood clots and extravasated urine. The bleeding is then arrested and the injury of the urethra found. If the rupture be incomplete the urethra is treated as in external urethrotomy for other causes (page 1294 *et seq.*), or repaired in a manner indicated (Figs. 1502 and 1503). If the rupture is complete no difficulty attends the recognition of the distal extremity of the canal, as the instrument is seen passing through it. The finding of the proximal end, however, is often tedious and difficult, requiring the same care and scrutiny that characterizes its discovery in perineal urethrotomy without a guide (page 1252). After securing the proximal end repair can be effected by sewing over a catheter introduced for the purpose (Figs. 1502, 1503, and 1504). When the proximal end can not be found the blood and urine usually will readily escape, and the danger of further extravasation will be prevented. However, if plastic repair of the urethra be contemplated, or retention of urine be likely to happen, it will be necessary to open the bladder above the

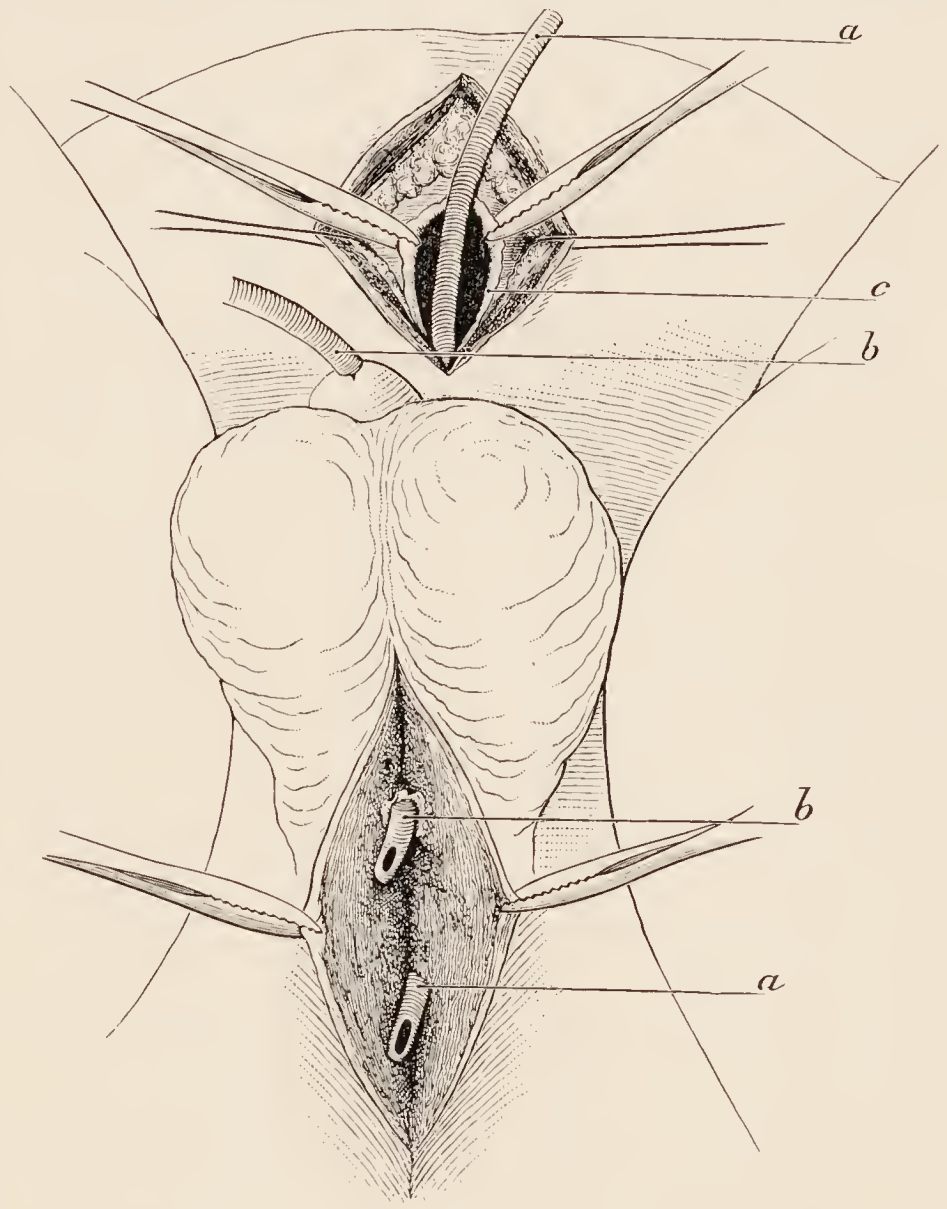



FIG. 1505.—Complete rupture of urethra, proximal end not found, retrograde catheterism. Introduction of catheter preparatory to sewing, a retrograde introduction practiced only when the proximal ruptured end can not be found for the purpose of sewing. Suprapubic opening utilized for drainage. *a*. Extremity of intravesical catheter. *b, b*. Extremities of catheter in penis. *c*. Wall of bladder.

pubis (Fig. 1312) and practice *retrograde catheterism* to prevent the latter; also to accomplish the former purpose (Fig. 1505).

*The Precautions.*—Carefully avoid injury of the structures by persistent efforts in passing a catheter or staff. Operate promptly to prevent needless extravasation of urine and consequent suppuration and fistulæ. Extravasation between the layers of the triangular ligament (Figs. 1374 and 1379) and beneath the superficial perineal fascia do not cause tumefaction until after rupture of the fascial restraints and the consequent extended infiltration (page 1182). It should not be overlooked that a catheter, while plugged with blood, when introduced into the bladder through the proximal end of a ruptured urethra will not permit urine to escape; otherwise it may be thought that the instrument has gone astray. However, if the eye of the instrument be cleared by a stream of water, and other facts relating to catheterism of the bladder already noted (page 1110) be heeded, this perplexity will be speedily removed.

*The Results.*—In 29 reported cases of rupture of the urethra treated by immediate suture, all are announced as successful. These results are astonishing and commend repetition.

*The After-treatment.*—Place the patient in bed with hot fomentations to the abdomen; elevate the scrotum to prevent infiltration; administer anodynes and demulcents, and keep the patient quiet. The major portion of the perineal wound may be closed by sutures carried deeply, leaving, however, sufficient room for the introduction of a large, flexible catheter through the neck of the bladder, which is fastened in place by means of tapes (Fig. 1494). It is allowed to remain in position for four or five days, unless its presence causes some degree of vesical irritation. The wound should be dressed antiseptically. The catheter should be kept clean by regular antiseptic injections and not allowed to extend too far into the bladder. After removal of the instrument, regular catheterization at short intervals should be practiced for a time. The use of boric acid or salol urotropen for urinary sterilization is important. Suitable-sized sounds should be passed every two or three days for a considerable time at a later period, in order to gain a urethra of the normal caliber and thus secure closure of the perineal opening.

*The Results.*—In 8,000 cases of external urethrotomy performed some years ago, a little over 5 per cent died. Stricter aseptic measures have lessened this rate.

**Internal Urethrotomy.**—Internal urethrotomy consists in the division of strictures by cutting instruments introduced within the urethra. The division may be made from before backward or from behind forward, depending on the extent of the stricture and the inclination of the surgeon. Ordinarily they are cut from behind forward. The roof or the floor of the urethra may be divided in either instance, the division of the former being regarded the safer and better procedure. Thorough asepsis should be practiced in all cases.

Internal urethrotomy should be limited to strictures of the penile portion. The subpubic strictures and those of the membranous portion should

be divided through the perinæum. *The number, size, location, and extent* of the obstructions should be determined before their division is attempted.

If it be the intention of the operator to distend the canal to its fullest capacity, and if the meatus be undersized, the latter should be enlarged before the stricture is divided. Enlargement can be easily accomplished by means of the *bistouri caché* of Civiale (Fig. 1506). After properly distending the meatus the bistoury is introduced with the cutting surface downward, and quickly withdrawn. The ordinary probe-pointed bistoury, or a straight-edged one, with the end guarded, will accomplish the purpose perfectly. The lips of the cut will unite unless they be kept separated by aseptic lint or cotton, or by the occasional introduction of a large-sized sound. The location, number, and size of strictures can be determined by the introduction of metallic (Fig. 1507) or gum-elastic (Fig. 1494) bulbous bougies of assorted sizes. One of large size that will slip through the meatus is selected, oiled, and passed down the canal until arrested. The distance in the canal is noted on the handle. It is then withdrawn, and the size of the bulb measured by the familiar scale.

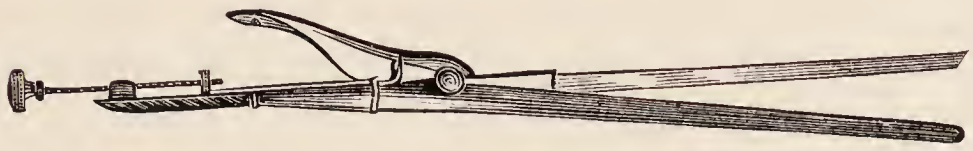


FIG. 1506.—Civiale's *bistouri caché.*

The surgeon next ascertains the size of the bougie that will pass the obstruction, and so on, recording the location and size of each obstruction in its turn until the bladder is entered. The urethrometer of Otis (Fig. 1508) is constructed on a principle calculated to give practically accurate measurements. The unexpanded blades of the extremity of the instrument, *b*, are covered by a small, thin rubber cap, *c*; the instrument is oiled and carried, closed, through the last obstruction, if possible, when the extremity is expanded by a screw at the outer end until it fills the urethra, the capacity of which is noted upon the




FIG. 1507.—Otis's bougies *à boule* (metallic).

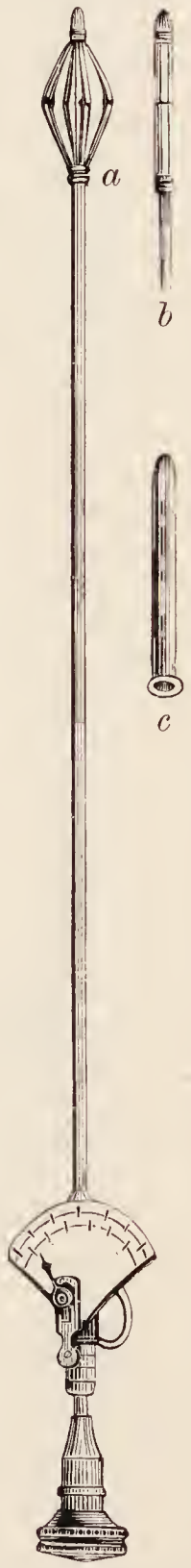



FIG. 1508.—Otis's urethrometer. *a.* Blades expanded. *b.* Blades unexpanded. *c.* Rubber cap.

dial; it is slowly withdrawn while the expanding extremity is regulated to accommodate the varied dimensions of the canal, the caliber of which, in the different locations, should always be noted. By this simple though ingenious method the surgeon is enabled to locate quite correctly the seat and caliber of the obstacles he is to treat.

*Urethrotomes*, like other instruments designed for special purposes, vary in many



FIG. 1509.—Otis's curved urethrotome, expanded and closed.

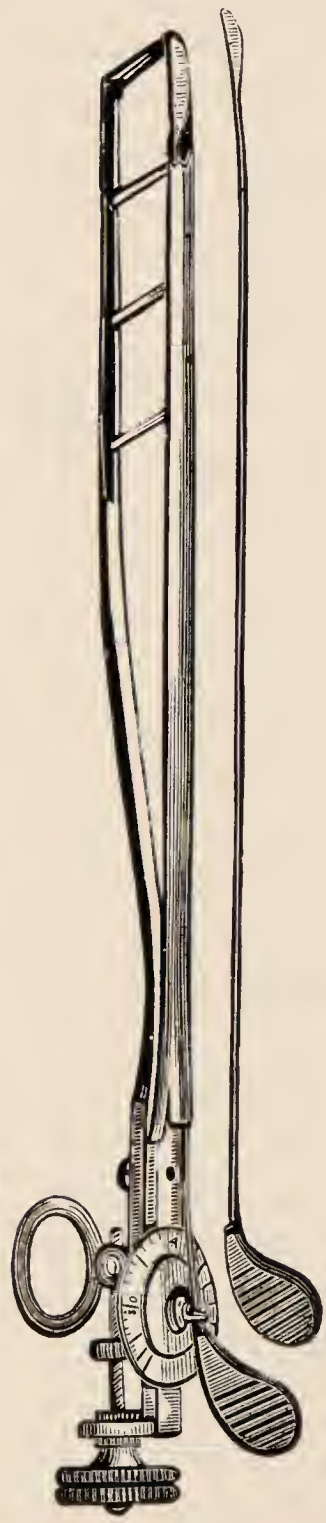


FIG. 1510.—Otis's straight urethrotome, expanded.

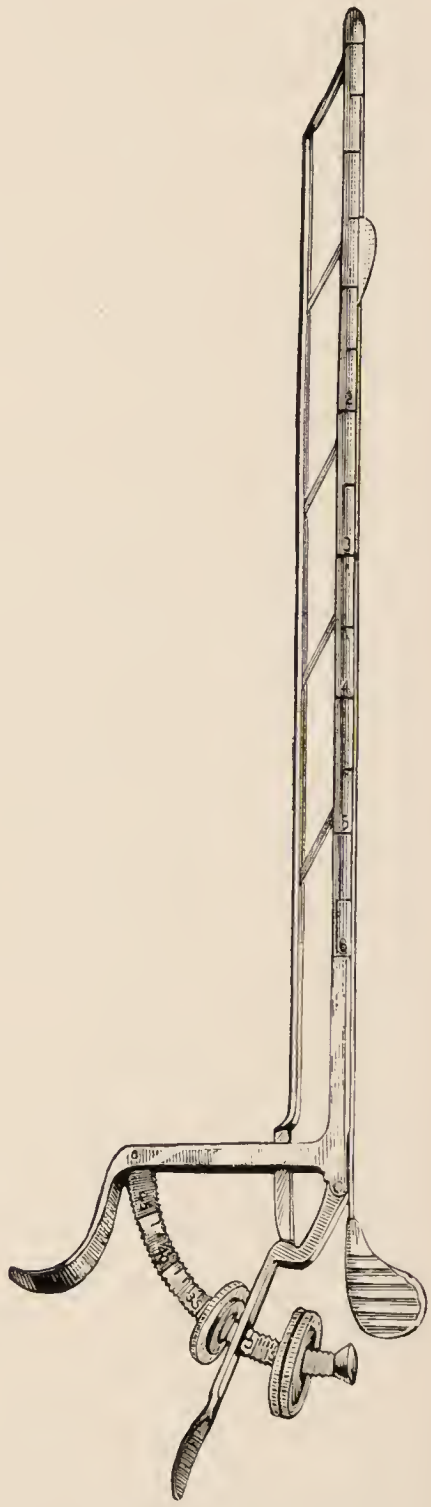


FIG. 1511.—Peet's urethrotome, expanded.

important particulars. Those, however, of greatest practical utility were devised by Otis and by Peet (Figs. 1509, 1510, and 1511). Each bears upon its handle a scale which enables the operator to ascertain not only the size but the distensibility of an obstruction. Either of these instruments when taken in connection with the urethrometer, enables the surgeon to

divide the strictured parts until the scale on the dial or handle of the cutting instrument indicates that the strictured portions of the urethra correspond in size to the dimensions of the normal portions, as already indicated by the dial of the urethrometer.

*The Operation.*—After cleansing the urethra a general anæsthetic or cocain solution is employed, and the patient is placed upon the back. Then a well-oiled aseptic instrument is introduced, and the extremity concealing the blade is carried beyond the obstruction, which is dilated by turning or depressing the screw at the end until the strictured tissues are made tense, when the knife is withdrawn sufficiently to divide the stricture freely. The action of the instrument is then reversed and the knife pushed back into its hiding place, and the instrument again dilated to note the effect of the incision upon the caliber of the stricture. If the caliber still be below the standard, as indicated by the urethrometer, incision is again made. In this manner each constriction can be divided and the urethral tube made of a uniform diameter throughout. If two or more strictures have a common, or an almost common, diameter, they can be cut simultaneously by drawing the knife along the course of the shaft. There is little danger of cutting the healthy mucous membrane so long as the dial on the urethrotome indicates a smaller dimension than that of the normal urethra, as shown by the urethrometer.

*The Complications.*—If severe hæmorrhage follow, a large-sized sound can be introduced, and the penis bandaged to it. Cold may be applied by means of a stream of iced water conducted through a double-barreled catheter. It is sometimes necessary to make pressure on the perinæum, in conjunction with other expedients. The necessity for this is extremely rare. Unless aseptic care be exercised in the manipulations directed to the arrest of hæmorrhage, septic poisoning may result.

*The After-treatment.*—Following urethrotomy the patient must be kept quiet in bed for three or four days, with a light diet and open bowels; demulcent and alkaline drinks are often advisable. A sound may be passed every third day until the wound is healed.

*The Results.*—Few patients perish as the direct result of internal urethrotomy, and, when carefully done upon proper cases, an unfavorable result need not be anticipated. If, however, severe bleeding happen, requiring urethral manipulation to arrest it, septic changes may be caused and an unfavorable outcome result. The inclination to perform internal urethrotomy has abated much indeed in the last few years, and wisely, too, as it appears to the writer. The paraphernalia for arrest of hæmorrhage arising from too free or incautious division of strictures is so suggestive of ominous outcome in many cases as to inspire the caution in division that has been followed by more conservative action and consequently a lessened rate of disaster from complicating causes.

**The Tapping of the Urethra** (Cock).—Tapping the urethra in a distended bladder from impassable stricture is a feasible operation under urgent circumstances. The patient is placed in the lithotomy position, and the left index finger introduced into the rectum, and its tip pressed against the apex

of the prostate (Fig. 1512). A double-edged knife is then plunged into the perinæum in the median line, the point being directed to the tip of the finger, and caused to open the urethra in front of the prostate, behind the stricture, by a slight lateral motion. As the knife is withdrawn, the dimensions of the wound may be increased anteriorly. A grooved director is then carried into the bladder through the opening, and a catheter passed upon it to relieve the distended viscus. The opening may be made through the anterior wall of the rectum when objections exist to the perineal puncture. The knife should not be withdrawn until the director is passed into the bladder, otherwise the line of incision may be lost. Suprapubic aspiration should be employed in place of rectal and urethral tapping, when possible.

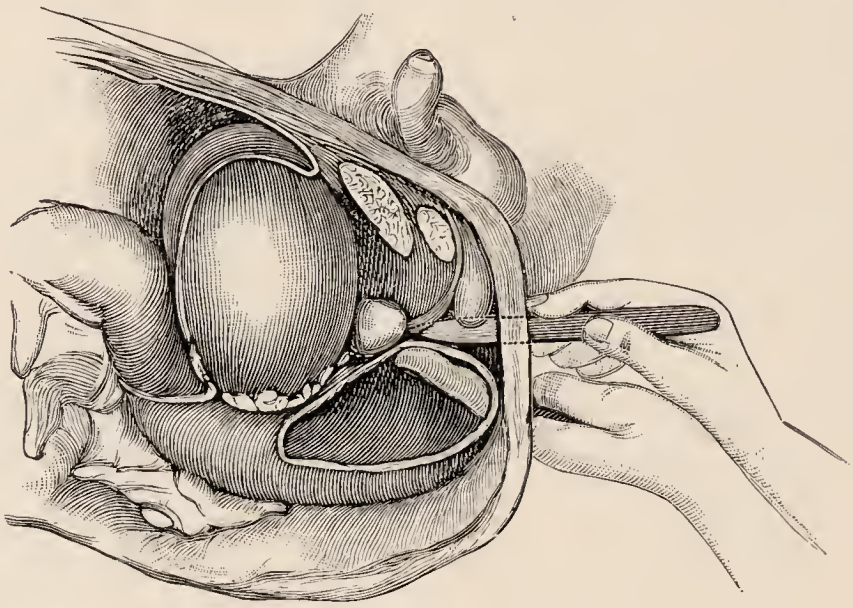


Fig. 1512.—Tapping urethra.

## MISCELLANEOUS OPERATIONS.

**Psoas Abscess.**—Psoas abscess can be opened directly from behind with comparatively little danger, and with the attainment of good drainage. Although *Israel* operated first, to *Treves* more than to any one else belongs the credit of the establishment of the simplicity of the operation from an anatomical standpoint.

*The Anatomical Points.*—The width of the erector spinæ muscle (about three inches), and the arrangement of the lumbar fascia with reference to the erector spinæ, the quadratus lumborum, and the psoas magnus muscles, and to the borders of the vertebræ, should be carefully noted before operation (Figs. 1033 and 1034). The length and shape of the transverse processes of the lumbar vertebræ and their connections should be recalled also. The detail of the origin of the psoas magnus, the course of the lumbar vessels, the relation of important vessels and nerves to the anterior surfaces of the bodies of the vertebræ, are of much importance in suggesting the limitation of manipulative measures.

*The Operation* (Treves).—Make a vertical incision along the outer border of the erector spinæ, with the center midway between the iliac crest and the last rib (Figs. 1032, 1033, and 1034), two inches and a half in length down upon the lumbar fascia; divide the fascia and expose the fibers of the erector spinæ the entire length of the incision; separate the outer border of the muscle from the sheath, and draw the entire muscle toward the median line with retractors, thus exposing the anterior layer of the sheath—i. e., the middle layer of the lumbar fascia; divide the anterior layer of the sheath vertically as near to its connection with the tips of the transverse processes




FIG. 1513.—Instruments employed for operation on psoas abscess.

*a*. Large and small scalpels. *b*. Forcipressure. *c*. Short blunt-pointed, straight and curved scissors. *d*. Dressing and mouse-tooth forceps. *e*. Blunt and hooked retractors. *f*. Sponge-holder with sponge. *g*. Barker's flushing gauge. *h*. Long curved needle. *i*. Grooved director. *j*. Perforated drainage tube. *k*. Long silver probe. *l*. Scoop. *m*. Catgut ligatures. Silkworm-gut sutures, wipers, small sponges, bandages, and an aspirating needle, etc., are required.

as convenient, thereby exposing the quadratus lumborum muscle (Fig. 1032); sever the muscular fibers close to the end of a transverse process, and enlarge the incision cautiously to the full extent of the wound; divide the anterior layer of the lumbar fascia, and expose the outer border of the psoas magnus muscle; sever some of the tendinous fibers of the psoas from the transverse process, close to the bone anteriorly; introduce the finger beneath the muscle and carry it gently along the surface of the process to the anterior aspect of the body of the vertebra, thus entering the abscess cavity; continue the exploration with the finger until the extent and condition of the vertebral structures are determined as far as practicable. Irrigate the abscess cavity with a solution of bichloride of mercury (1 to 5,000), causing the fluid to come in contact with every aspect of the wall by manip-

ulation and change of the position of the patient, and repeat the emptying and filling of the abscess cavity; remove the pyogenic lining by scraping with the fingers also isolated collections of carious matter; instead of the fingers, small, fine sponges can be employed, on a sponge holder, and introduced into every part of the cavity, which is scoured in turn by vigorous to-and-fro and rotatory movements of the sponge. The flushings and sponging of the cavity are repeated until no gross evidences of disease any longer appear. The cavity of the abscess is then wiped dry with sponges, and the wounds are closed by silkworm-gut sutures carried deep enough to include the muscular and tendinous structures. An aseptic dressing, secured in place by a body bandage, completes the operation.

*The Precautions.*—Care should be exercised in cleansing the abscess cavity not to encroach on the thin walls, and thus injure the abdominal vessels (Fig. 898). A close adherence to the spinous processes in reaching the abscess insures against danger of injury to the lumbar arteries. If the incision be directed too far outward, the peritoneal cavity may be opened.

*The Remarks.*—If the patient be thin, the seat of disease is easily reached; if very stout, much difficulty in reaching it is experienced, and it may be impossible to do so in some cases. The side selected depends on convenience of operating and the seat of the preponderance of the disease. The right side is somewhat more convenient, but this is not of sufficient moment to lead one to disregard the importance of attacking the disease at the seat of the greatest development. In the presence of marked kyphosis, the space between the crest of the ilium and the last rib may be much reduced and even almost abolished. The flushing gouge of Barker already described (Fig. 326, *d*, page 374) can be used to cleanse the abscess cavity of the products of disease. Hot water, at a temperature of 110° or 112° F., can be used in washing. The introduction into the cavity of the abscess of the iodoform emulsion, followed by closure of the wound, and antiseptic dressing retained in place undisturbed for a week or ten days, is often followed by prompt healing and cure. Incision at the posterior border of the sterno-mastoid, so as to reach the brachial plexus, which, as a guide, leads to diseased bone in the cervical region, has been practiced.

*The After-treatment.*—The after-treatment is that directed to the cure of Pott's disease, and raises the question of absolute rest in bed for an indefinite time, *versus* the use of artificial support with out-of-door advantages, a question which can not be discussed here. If the wound does not heal at once, or the line of union breaks down, the washing-out and scrubbing process can be repeated.

*The Results.*—While success has attended the operation in some cases, the outcome, as a rule, is unfavorable.

**Suture of the Patella for Fracture.**—Suture of the patella with wire is now generally accepted as a justifiable measure in selected cases. In our opinion, the operation should not be performed except for other reasons than that of the existence of a simple fracture of the bone, because we do not believe that it is good surgery to expose a patient to the contingencies of suppuration, amputation, anchylosis, and even death, for the better rectifica-

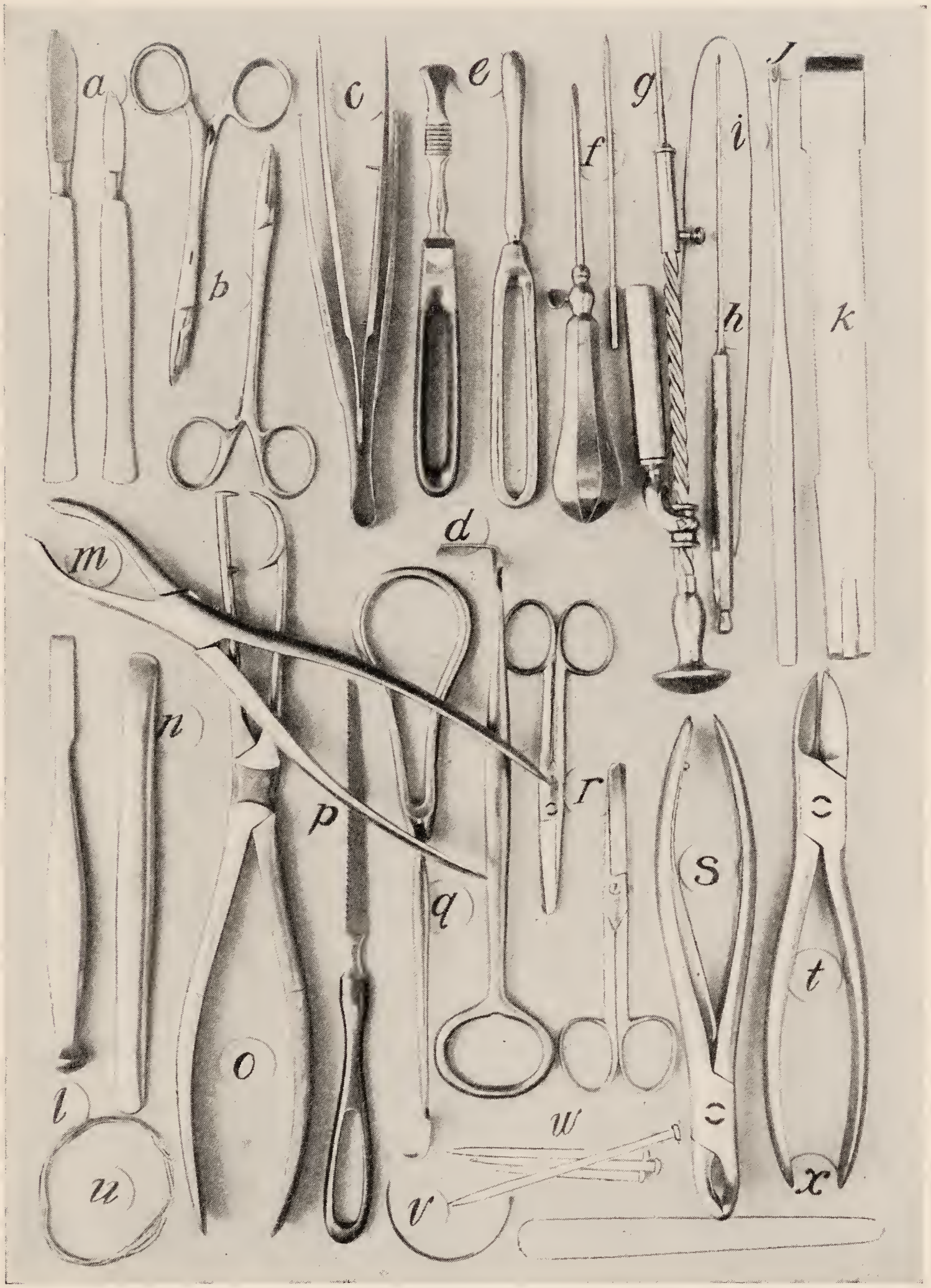



FIG. 1514.—Instruments employed in repair of fractures of patella and long bones.

*a*. Scalpels, large and small. *b*. Forcipressure. *c*. Forceps, thumb and mouse-tooth. *d*. Rugine. *e*. Volkmann's scoop. *f*. Brainard's bone drill. *g*. Hamilton's bone drill. *h*. Fluhrer's crochet drill. *i*. Silver-wire suture. *j*, *k*. Fluhrer's fork and grooved retractor. *l*. Chisel. *m*. Toothless iron-jaw forceps. *n*. Periosteotome. *o*. Phelps's instrument for holding fragments of patella. *p*. Saw. *q*. Retractors, hooked and blunt. *r*. Scissors, straight and curved. blunt-pointed. *s*. Rongeur. *t*. Bone-cutting forceps. *u*. Silver wire. *v*. Curved needle. *w*. Ivory pegs. *x*. Spatula. Silkworm gut, catgut, silk, sponges and wipers, and fine curved needles are required.

tion of an injury which, at its worst, has no tendency to terminate fatally, and almost invariably results in a serviceable limb when treated by the ordinary methods. It is as impossible as it would be unwise to indicate definitely the cases for wiring, as each case should be considered on its own merits. When the end to be gained will justify the attempt, the operation need not be deferred.

Thorough aseptic measures should be employed in connection with every essential detail of the procedure.

*Three different incisions* are practiced in this operation: the vertical, the transverse, and the oval. *The vertical incision* is made in the median line of the bone down upon the fracture, and is of sufficient length to permit the ready exposure of the line of fracture and afford room to cleanse the joint. In this instance, one or two wires —now usually one—is employed, and is placed at the median line in front. The writer has practiced this form of incision frequently, and with entire satisfaction. It places the scar vertically, and obviates the danger of stretching or rupture when overflexion happens. The incision does not afford as favorable an opportunity to trim and repair the lateral laceration of the capsule as transverse incision, and directly invades the prepatellar bursa (Figs. 378 and 1522).

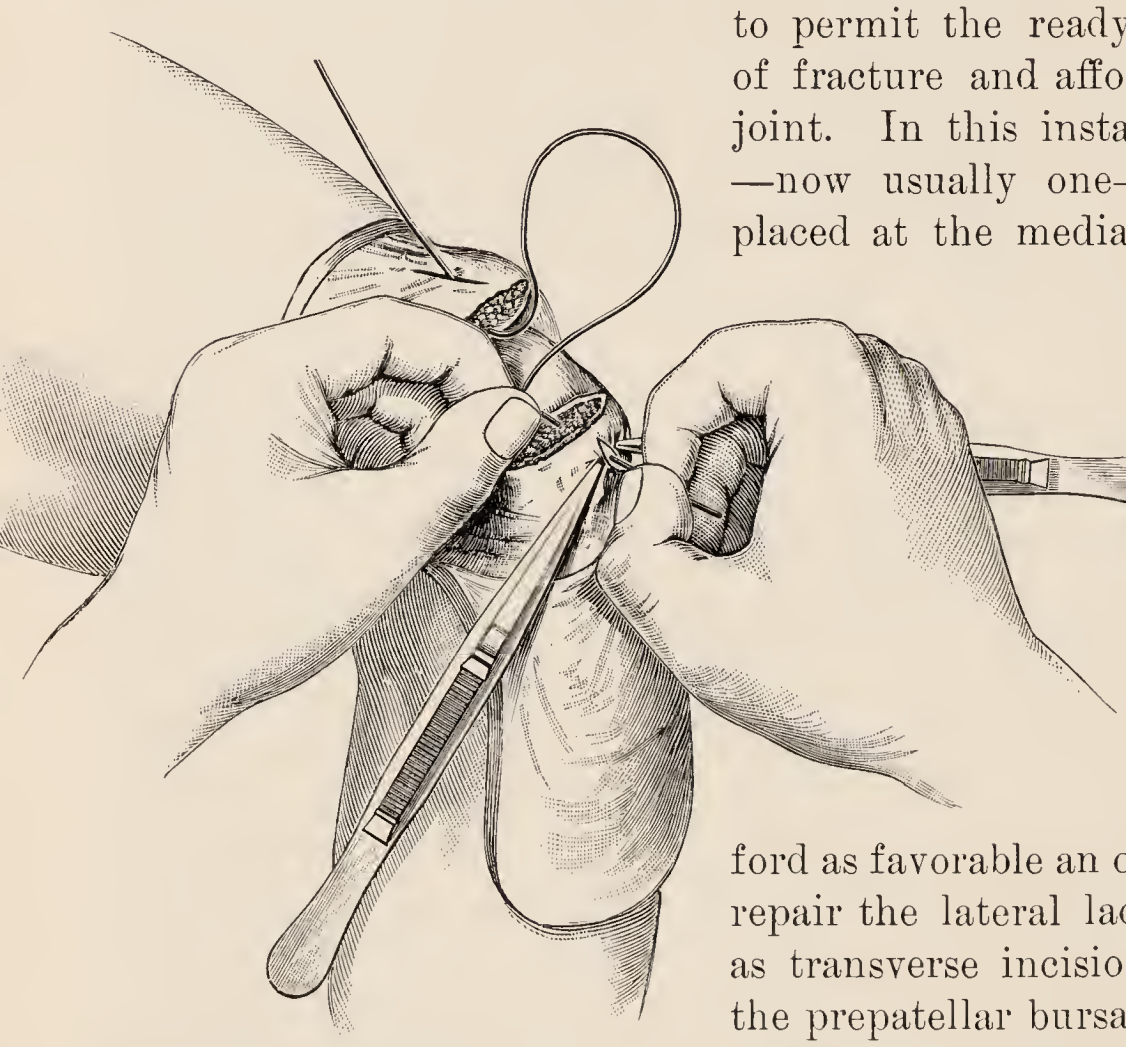


Fig. 1515.—The operation of suture of patella, Cheyne's oval incision. Introduction of wire through lower fragment; leg flexed.

*The transverse incision* is made directly across the joint, between the inner and outer aspects, at or close to the line of fracture. This form of incision permits of extended examination of the joint cavity and the repair of lateral laceration of the capsule. However, the cicatrix is exposed to the influence of direct and to flexion violence, and in many instances refracture has been complicated with laceration of the cicatrix. This incision is almost certain to open the prepatellar bursa (Figs. 378 and 1521).

*The oval incision*, with the convexity downward or upward (Cheyne), is a good form of incision. It affords the same opportunities as the transverse one, but with less danger of subsequent complications. It extends between the outer and inner aspects of the knee and considerably below or above, as the case may be, of the line of fracture in front. *Lucas-Championnière* is an earnest advocate of the flap method. It should not involve the prepatellar bursa.

*The Operation.*—Place the patient on the back with the limb extended and the heel raised; expose the fracture freely, and, if need be, the joint cavity through the selected incision; remove blood clots from the broken aspect of the fragments with a bone scoop, and intervening fibrous and other tissue with scissors, so that the fractured surfaces can be brought into proper apposition; remove from the joint cavity, by means of sponges and hot saline solution flushing, blood clots and foreign bodies, giving especial attention to the upper synovial pouch (Fig. 378, *a*), and to the recognized anatomical recesses of the joint; if drainage is to be introduced, carry silkworm-gut drainage into the joint through a perforation of the tissues made at the lower part of the external condyle from within outward by means of a long, sharp-pointed scissors curved on the flat; flex the leg and bore each fragment (Fig. 1515) deeply or superficially at one or two situations for large or small wire, as circumstances may demand (Fig. 1516); cleanse the joint cavity again, and bring the fractured borders in contact with each other by twisting the ends of each wire together along the line of a corresponding incision made down to the bone by a sharp-pointed knife, as firmly as is consistent with the security of the union (Fig. 1517); cut off the twisted ends a quarter of an inch or so above the

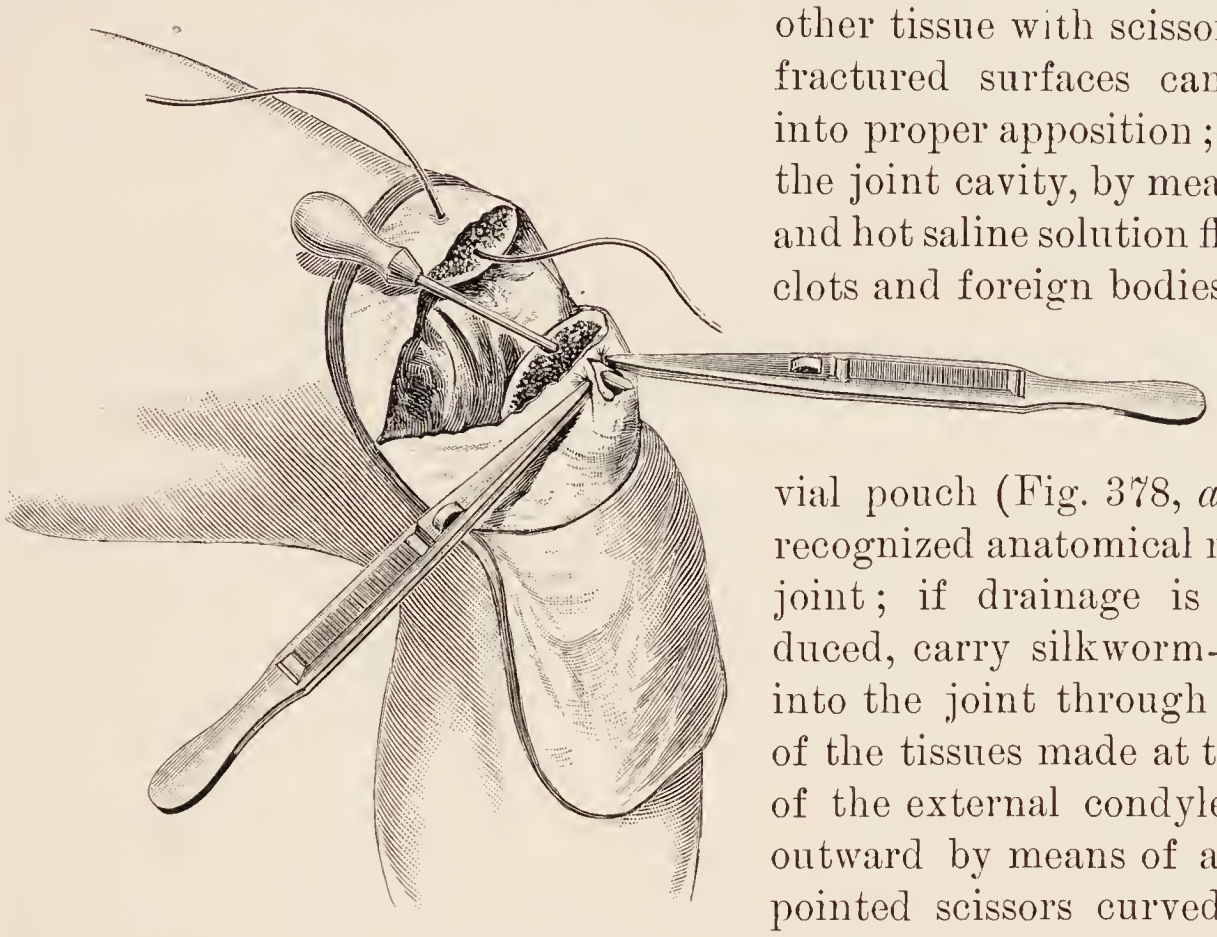


Fig. 1516.—The operation of suture of patella, Cheyne's oval incision. Drilling lower fragment; forceps drawing aside divided fibrous tissues; leg flexed.

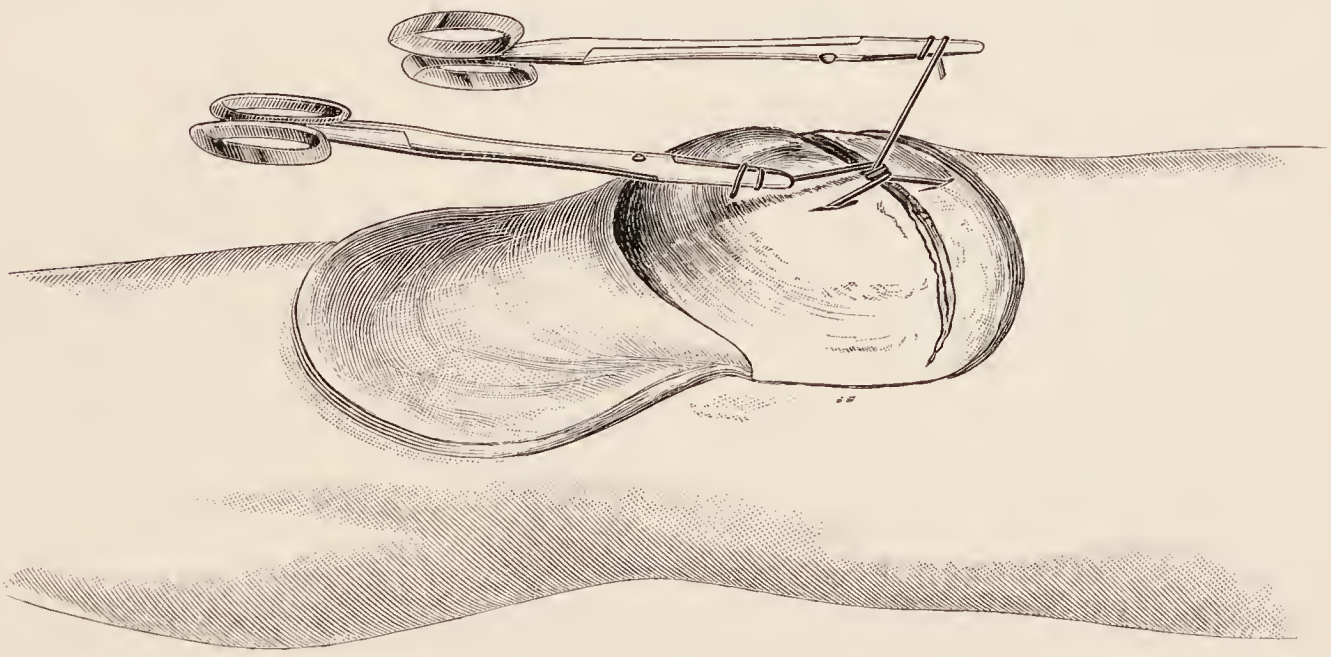


Fig. 1517.—The operation of suture of patella, Cheyne's oval incision. Bringing fragments together; leg extended.

bone, and flatten them against the bone (Figs. 1518 and 1527), for obvious reasons; trim the torn borders of the capsule, if desirable, and close the gap with an interrupted or continuous catgut or kangaroo-tendon suture; unite the divided borders of the patellar fibrous tissue with fine catgut, thus shutting off the more completely from the external wound the joint cavity; close the external wound with interrupted silkworm-gut sutures carried deeply; dress the wound, and confine the joint immovably in an extended position until repair of the soft parts has taken place.

*The After-treatment.*—The after-treatment is like that of similar wounds at other parts of the body. When the healing of the soft parts is completed the limb may be encased in a fenestrated plaster-of-Paris splint, and thus the patient may be around on crutches until bony repair is established. Usually patients are up and about with the joint controlled by a plaster-of-Paris casement or only by a posterior support at the end of the third week. *Phelps* begins early to move the patella, thus fitting it for use at a timely period. Massage is an essential element of after-treatment.

*The Precautions.*—Thorough asepsis should be had to forestall the possibility of suppuration of the joint cavity. Compound fractures of the patella should be wired at once, simple ones, as a rule, at a later period—eight or ten days after the accident (Phelps). It is advised by some, and is justifiable under unfavorable environment, to employ the douche during the operation. In case suppuration occurs the pus should be liberated at once, the joint freely washed with a bichloride solution, rubber drainage tubes introduced, and continuous irrigation with a warm bichloride solution (1 to 10,000) applied until the suppuration ceases and repair begins. If pus be present in the superior pouch (Fig. 378, *a*) it should be drained—and better above—to prevent purulent infiltration of the tissues of the thigh. Too vigorous or too early passive motion may cause refracture attended even with laceration of a transverse scar. Observe, in wiping the joint with sponge or gauze (small pads), that fragments of the former and threads from the latter do not remain behind to cause inflammation; periarticular suppuration may happen without involvement of the joint. If both periarticular and articular drainage be provided, the presence of pus in either place can be easily and readily detected, and evacuated at the earliest moment without the danger of speculative delay. The fragments in old fractures are apt to be porous and friable and easily torn through by the wire. Drainage should be employed or not, according to the surgeon's judgment of the individual case. He should strive to do that which gives to the patient the greatest security, rather than that which, while emphasizing his confidence and skill, may unnecessarily lessen the patient's security—the precept being, not what one can, but what one ought to do.

*The Remarks.*—In the writer's judgment the articular and periarticular spaces should each be drained independently with a thread or two of silkworm gut in all instances of uncertainty. The measure does no harm and may forestall grave disaster. The trimming and repairing of the lacerated capsule does not seem necessary, as is shown by the uniformly good results—so far as the capsule is concerned—in the non-operative and subcutaneous

methods of treatment (Figs. 1521 and 1524). And it is not improbable that the resulting shortening of the capsule from repair adds to the difficulty of the proper attainment of post-operative movement, to say nothing of the greater exposure of the joint to infection during the repair. Disconnected fragments of bone liable to necrose should be removed. When the bone is broken into three or more fragments, a sufficient number of sutures should be employed to secure suitable apposition of the pieces (Fig. 1518). In the instance of old fracture with irreducible separation, the quadriceps extensor tissues can be lengthened by making a V-shaped or oblique incision (page 1269) through them sufficiently to permit bony apposition. The wire should not be carried through the under surface of the patella (Fig. 1519). When an upper or lower fragment is very small, and when the bone is comminuted, *Lejars* surrounds and holds in place the fragments by means of silver wire passed through the median line of the quadriceps and patellar tendons and close to the borders of the fragments, so as to confine them in proper place when the ligature is tightened. *Ceci* treats fractures of the patella in a similar manner with silk ligature (page 1268). The practice of exposing the fragments by means of a vertical or transverse incision, removing the blood clots and uniting the fragments with kangaroo-tendon, silk, or catgut sutures passed through the margins of the fibrous tissue lying on the patella, the same as in fracture of the olecranon process (Fig. 1532), is favorably considered in those cases with but little tendency to separation of fragments or the occurrence of hæmorrhage. The bony borders are not brought as closely in contact by this plan as by the use of wire. The facts that blood clots in a joint are thought sometimes to form movable bodies there and are known to be admirable culture media for germs in infected cases, emphasize the wisdom of their removal. At the end of four or five weeks all restraint is removed, and passive motion of the patella from side to side and flexure of the limb are begun, and the patient is encouraged to use the joint, which usually of itself alone will restore the function in a few weeks. Douching, friction, and electricity are sometimes advantageous as after-treatment measures. An elastic kneecap may be worn for a time as a reminder of infirmity, if for no other reason.

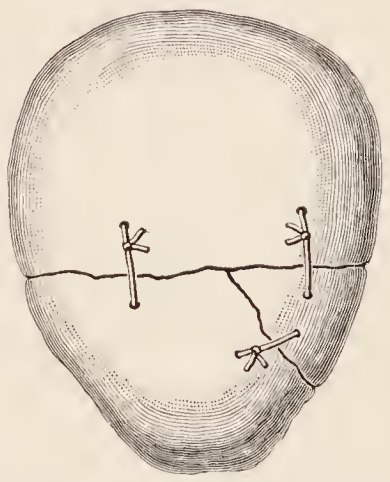


Fig. 1518.—The operation of suture of patella for comminuted fracture.

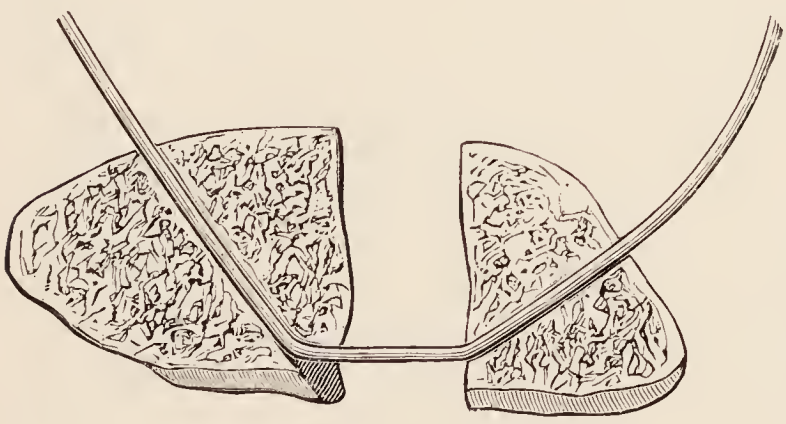


Fig. 1519.—Wire introduced.

*The Results.*—Prior to 1883 the patella had been wired 49 times, in which 2 of the patients died, 1 of pyæmia and 1 of exhaustion. Besides these, 6 cases resulted in suppuration and ankylosis. *Powers*, in his excellent study of "operative interference in recent simple fracture of the

patella,"* reported 711 cases, 474 of which were from personal communications and 237 were gathered from the literature of the two years preceding the presentation of the paper. Of the first series, 4 died; of the second, 6. Of the 10, 3 died from sepsis and the remainder from other causes not related to operative technique. Surely the difference in the results of the extremes (1883 and 1898) exhibits a commendable record of the product of experience. Powers ascertained the opinions of 67 prominent surgeons, living here and abroad, regarding the advisability or non-advisability of operative interference in simple fracture of the patella. *Seventeen* were "opposed to the operation in any case"; *nine* "would operate in all cases in which no distinct contraindication exists and in which the surroundings are satisfactory"; *forty-one* "would operate in selected cases, those with wide diastasis, comminution, etc." More pointedly stated, 17 would not operate on any case for any reason; 9 would operate on every case except for special reasons; 41 would operate only on selected cases and for special reasons.

However, the perplexing frequency of superficial suppuration and rare occurrence of deep suppuration, of ankylosis, "poor results," etc., to say nothing of an occasional amputation and an infrequent death, still emphasizes the need of wise discrimination in the selection of and greater care in the treatment of cases by wiring, and also by other methods that involve the joint. No operative plan that is much employed is without the history of an unfortunate outcome.

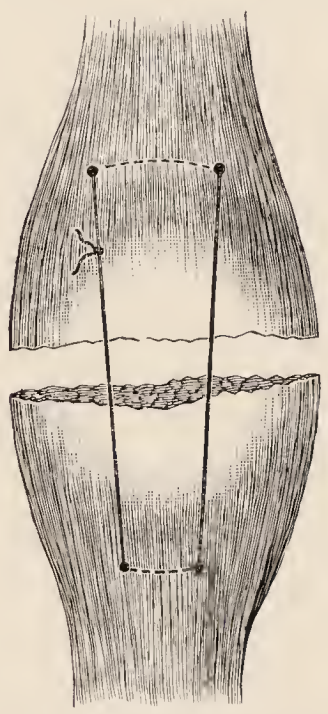


FIG. 1520.—The operation of suture of patella, Stimson's method.

**Stimson's Method of Treatment** (*Silk Suture*) (Fig. 1520).—In this method of treatment make a median longitudinal incision extending well above and below the fragments, down to the bone; remove the clots from the joint cavity and from the fractured borders of the bone; lift up from between the fragments the fibro-periosteal fringe that may be there; pass a strong silk suture transversely through the ligamentum patellæ, close to the bone, thence in the opposite direction transversely through the quadriceps tendon close to its insertion by means of a strong curved needle; hold the fragments in apposition and tighten and tie the suture; close the cutaneous wound without drainage, and confine the limb immovably until proper repair has taken place.

*The Results.*—"This method seems to be as simple as any, and has proved to be efficient and safe in more than fifty personal cases" (Stimson). In 1896 Stimson reported 75 cases with no accidents from the operation.

**Barker's Method.**—Barker's method is quite easy of performance and can be accomplished in a comparatively short time. *White* commends this method and has performed it fifteen times with entire success. He begins passive motion on the tenth day, gets the patient out of bed with a light

* Transactions of the American Surgical Association, 1898.

splint on the limb at the end of the third week, and expects good use in from eight to ten weeks.

*The Operation.*—Under strict antisepsis, with the patient on the back and the limb extended, steady the lower fragment with the thumb and finger; thrust a narrow-bladed knife with the edge upward, through the ligamentum patellæ at the point of insertion into the lower fragment, into the joint; carry through the wound thus made a pedicle needle (Fig. 1521), passing it upward beneath the fragments through the insertion of the quadriceps at the base of the upper fragment sufficiently to elevate the overlying integument; draw the integument upward and expose the end of the needle through a short incision made down upon it; push the end of the needle through the opening, and thread it with a strong sterilized silk thread or silver wire; withdraw the needle, leaving the ligature in place; unthread and pass the needle through the same primary opening upward in front of the fragments and out of the upper incision (Fig. 1522); rethread the needle with the upper end of the cord and withdraw the needle so that the ends of the silk will both present at the lower incision; approximate the fragments, and displace intervening blood clots and other material by rubbing them together briskly; tie the suture tightly, cut the ends short and close the wound (Fig. 1523). A posterior splint and a figure-of-eight bandage are then applied. Passive motion is begun on the tenth day in the majority of cases. The patient may be up and around with a plaster-of-Paris dressing in three weeks.

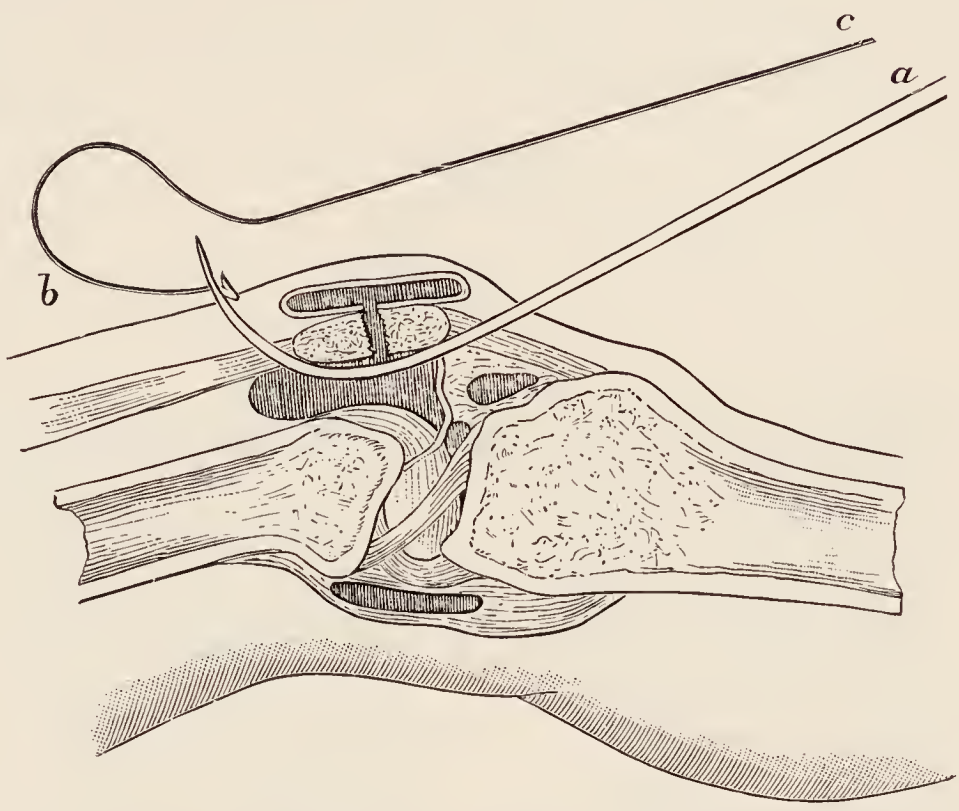



Fig. 1521.—The operation of ligature of patella, Barker's method. *a*. Needle passed beneath patella. *b*, *c*. Wire ligature in eye of needle.

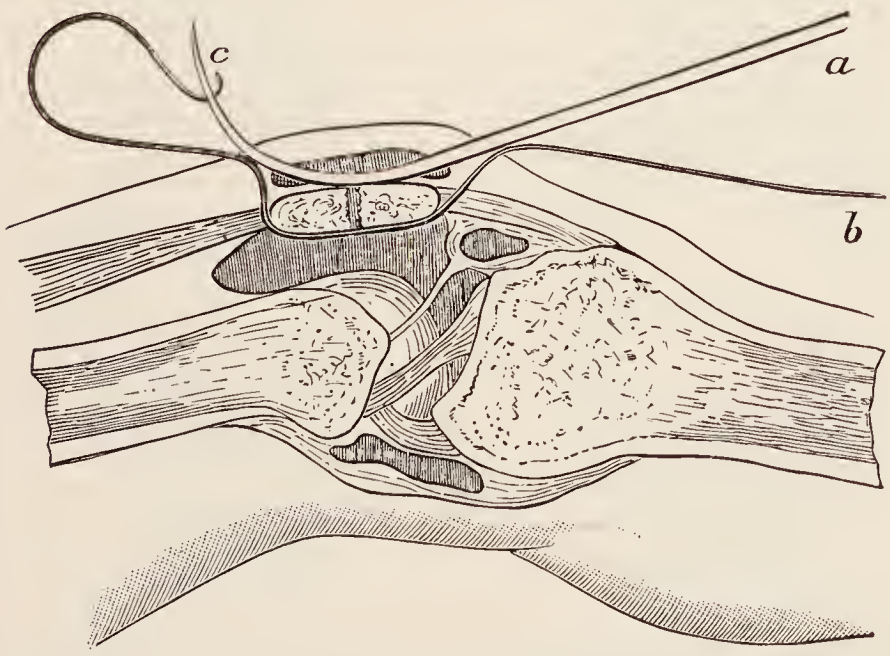



Fig. 1522.—The operation of ligature of patella, Barker's method. *a*. Needle passed in front of patella. *b*, *c*. Wire ligature in eye of needle.

*The Results.*—Good use of the joint is expected in two months. That this plan is safer than the freely open ones there can be no reasonable doubt. The practical outcome can not be known without a more extended experience.

*Another subcutaneous method* (Ceci) consists in surrounding the fractured bone subcutaneously with a buried silk ligature in quite the same manner Lejars employs in multiple fracture of the patella, and in fracture at its tendinous insertions, passed transversely through the ligamentum patellæ at its insertion into the fragment, and so carried around the bone, passing through the quadriceps attachment (Fig. 1524), as to draw the fragments tightly together in a hooplike manner when the suture is tightened, and tied at the point of primary puncture (Fig. 1525). The ordinary curved pedicle needle can be employed to draw the suture into place. Owing to the circular shape of the bone, the ligature must be laid in segments, the needle being reinserted at the point of exit in each instance until the primary puncture is reached, when the suture is tied as just described.

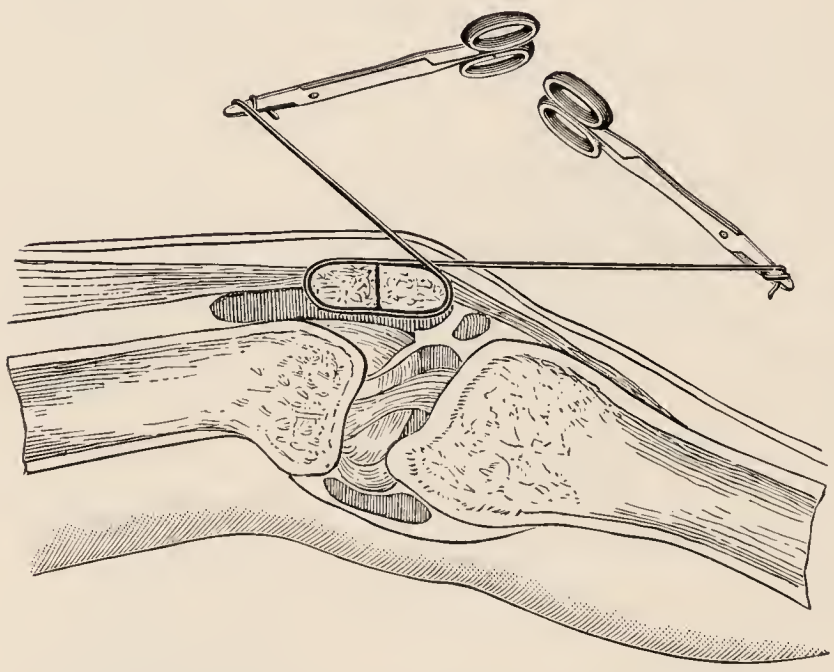


FIG. 1523.—The operation of ligature of patella, Barker's method. Twisting wire ligature; bringing fragments together.

*The Remarks.*—The suture should be carried sufficiently deep at the sides to penetrate the firm tissues connected with the patella at those situations, in order to properly control the fragments. In comminuted fracture the plan serves to unite the fragments closely. The remaining advantages claimed for the method are of questionable worth. Other methods of arrangement of the suture have been suggested and occasionally practiced.

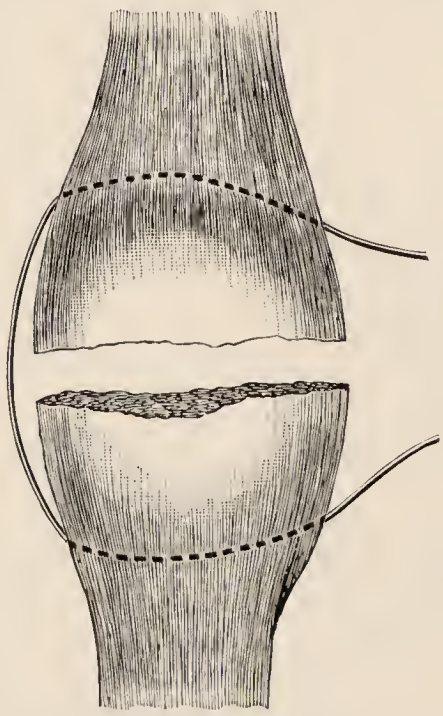


FIG. 1524.—The operation of subcutaneous (wire) ligature for fracture of patella, Ceci's method.

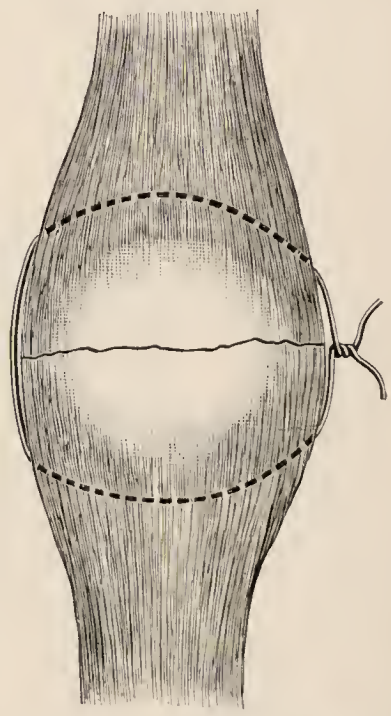


FIG. 1525.—The ligature united in Ceci's method. Silver wire may be used instead of silk.

**In old fracture of the patella,** especially with wide separation of the fragments causing a badly crippled limb, union of the broken parts in some instances requires division of the quadriceps tendon, and even the rectus

itself, along with the vasti muscles, and perhaps then suitable apposition can not be secured without separation by mallet and chisel of the tuberosity of the tibia from the normal site, and its transplantation and fixation at a higher point on the bone.

*The Anatomical Points.*—The length and width of the tendon of the quadriceps, and the length and direction of the lowermost fibers of the vasti in health, should be carefully observed before the operation is commenced. These lowermost fibers, which are markedly concerned in maintaining the patella in proper relation with the lower end of the femur, may have become so changed in their structure and function as to prevent apposition of the bony fragments unless they are freely divided, which division, however, quite severs the musculo-tendinous flap and the attached fragments of the patella from nourishment until after wiring of the bone and suturing together of the contiguous borders of the soft parts is completed, and exposes to serious danger of sloughing. The writer once encountered this obstacle in a marked degree. The relation which the site of operation bears to the joint cavity merits careful attention (Fig. 378).

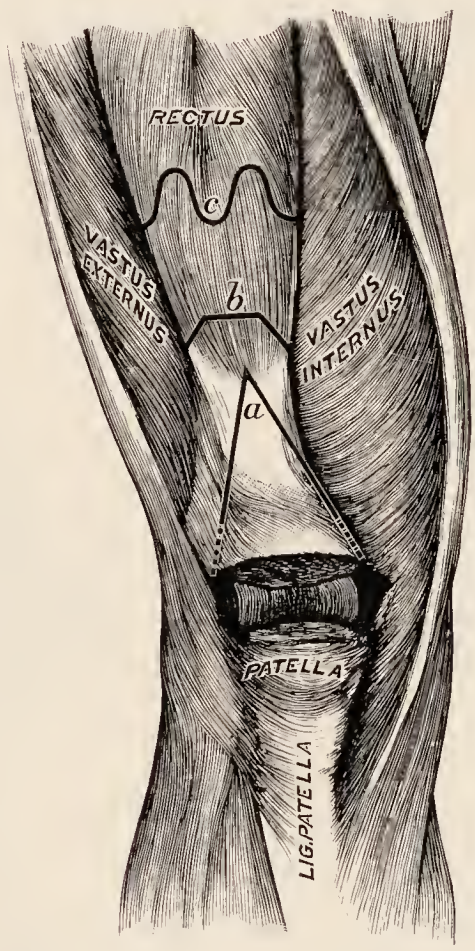



Fig. 1526.—The operation of elongation of the quadriceps in old fracture of patella. *a*. Triangular incision with dotted lines indicating extension of incisions. *b*. Gable-shaped incision (Keen). *c*. Crenate (Cheyne).

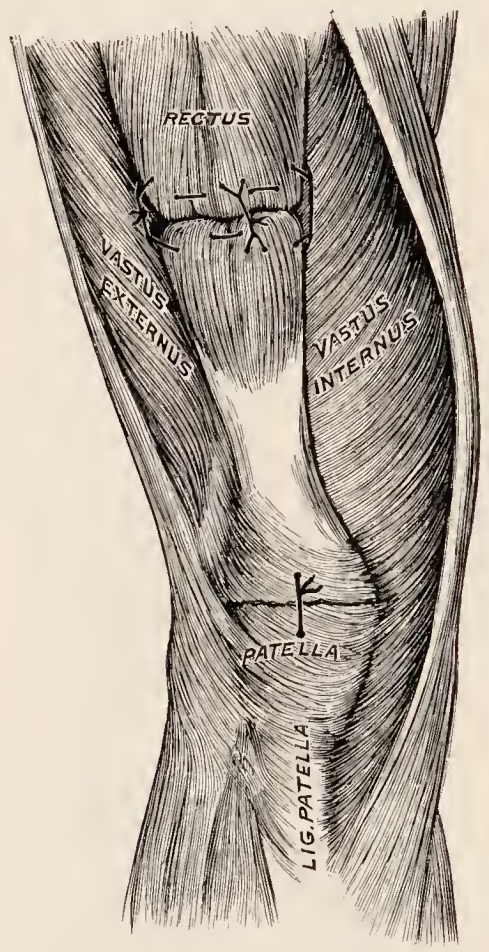



Fig. 1527.—The ends in crenate incision adjusted, united together, and patella repaired (Cheyne). In instances *a* and *b* (Fig. 1526), elongation followed by adjustment and suturing of contiguous borders are required.

The varieties of the liberating incisions employed are usually three in number: (*a*) the triangular; (*b*) the gable-shaped; (*c*) the crenated (Fig. 1526). In either instance the incisions should be made through the tissues, and after their elongation and the adjustment of the bony fragments the contiguous borders of the former are sutured together (Fig. 1527). The longitudinal incision affords the greatest and the remaining incisions the least degree of elongation. The greater the need for lengthening, the higher and more extended the oblique incisions should be made.

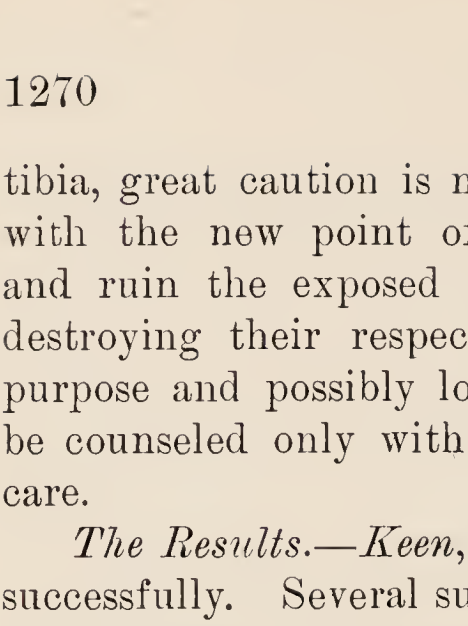
*The Precautions.*—Strict asepsis should be practiced. The incisions should conform strictly to the needs of proper joining of the bony fragments. In displacement upward and implantation of the tuberosity of the

tibia, great caution is necessary not to seriously impair its power of union with the new point of attachment. Since septic infection may invade and ruin the exposed joint and the union of the soft and hard parts, destroying their respective portions, thereby causing defeat of operative purpose and possibly loss of life, it is evident that the operation should be counseled only with wise discretion and performed with consummate care.

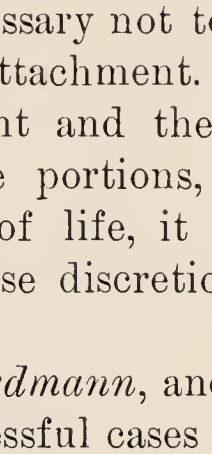
*The Results.—Keen*, *Erdmann*, and others have practiced these methods successfully. Several successful cases from other sources are reported.

**Rupture of the Tendon of the Quadriceps Extensor Femoris.**—The quadriceps tendon is sometimes ruptured from direct and indirect violence. Rupture may be mistaken for fracture of the patella, and, in fact, be entirely overlooked.

*The Operations for Rupture.* — In cases where *ruptured muscular extremities* can be brought together they may be suitably united by means of a supporting thread in the form of a transverse loop, passed through both of the ruptured extremities, supplemented by a few stitches for finer adjustment of the torn edges (Fig. 1528). In cases where the *ruptured ends are tendinous* (Fig. 1529), pass a long, heavy silk thread, by basting stitches, transversely through the two ends, about half an inch from their edges; unite by a continuous suture of fine silk the posterior margins of the ruptured ends. Now tie the transverse suture, and then unite the anterior margins with a continuous suture, over which sew the aponeurosis and skin. In cases where *the tendon is ruptured close to its bony insertion* pass a loop of silk or silver wire so as to include the




1



2

Fig. 1528.—1. Method of suturing divided muscle. Four sutures placed ready for tying to the bundles of muscle, and three are already tied to each other. 2. The arrangement of individual sutures, each grasping a bundle of fibers (page 302).

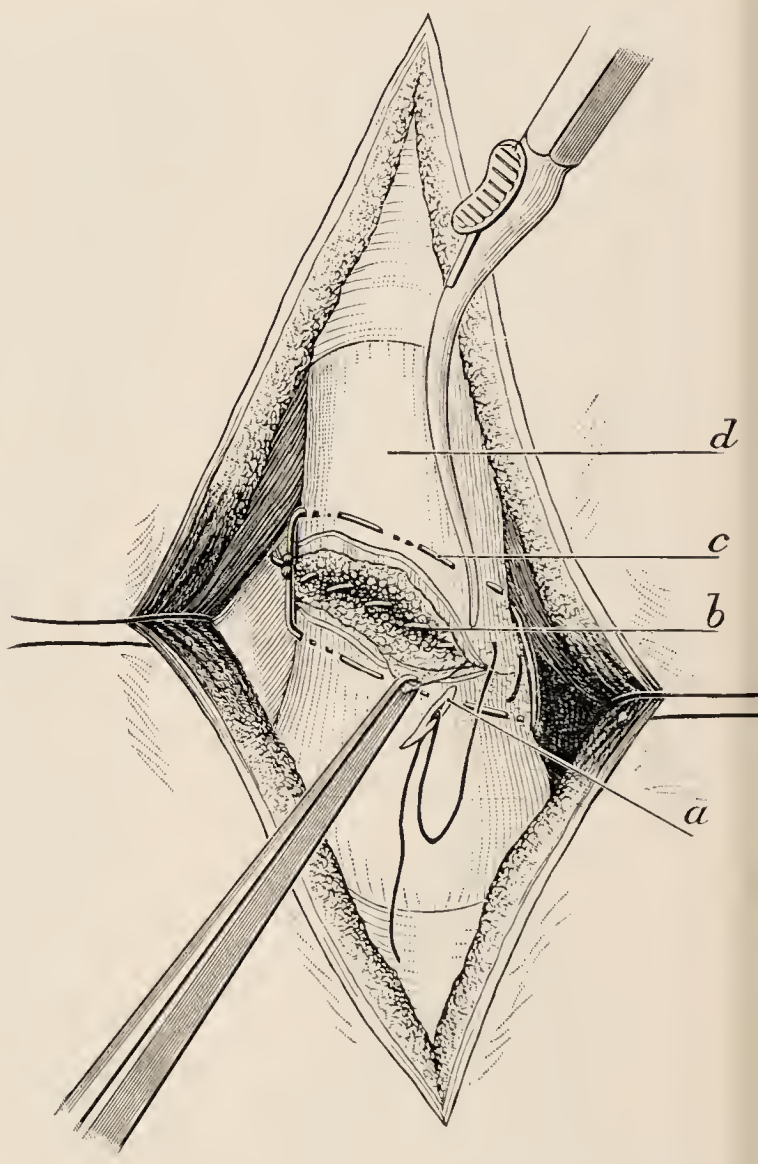



Fig. 1529.—Rupture of tendon of quadriceps extensor femoris. Uniting ruptured ends. *a*. Anterior continuous adjustment sutures. *b*. Posterior continuous adjustment sutures. *c*. Basting stitches. *d*. Tendon of quadriceps.

upper segment of the torn tendon above and the patella below (Fig. 1530). Draw the ends of the loop taut, thus bringing together the separated surfaces, completing the apposition by a continuous suture uniting the apposed edges. *If the gap be too large for coaptation of the ruptured ends*, *Championnière* recommends suturing at a distance by passing a loop of silver wire, basted in and out, around the lower part of the upper segment of the tendon, not far from its torn margin. This acts as a splint to support in this situation the two or three longitudinal stitches of approximation which are made to pass through the tendon just above it. Below, the longitudinal stitches pass either around a similar transverse splint stitch placed near the torn margin of the lower segment, or, if the latter is not of sufficient length, through the patella itself. The longitudinal stitches are likewise of silver. Around this metallic structure, in young subjects, it is possible that the area of loss of substance can be filled in by the development of regenerative fibrous bundles.

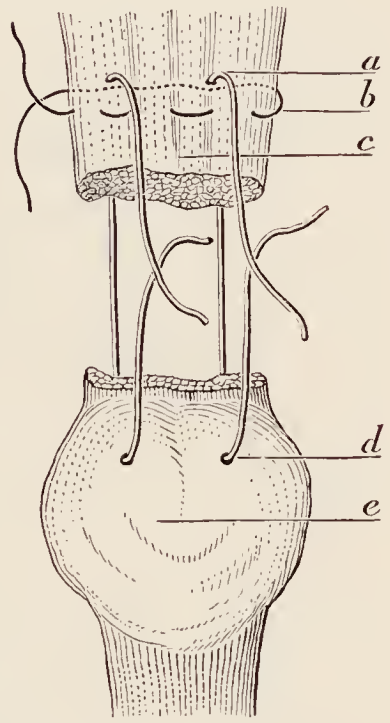



FIG. 1530. — Rupture of tendon of quadriceps extensor femoris. Uniting ruptured end of tendon with patella. *a*, *d*. Wire sutures. *b*. Basting stitches. *c*. End of tendon. *e*. Patella.

*The Remarks.*—If the bursa lying beneath the tendon (Fig. 378, *a*) has been ruptured it should be repaired, and due cognizance of the possible outcome on the knee joint from this cause be considered and provided for.

*The Results.*— *Walker's* analysis of 250 cases shows that 72.5 per cent recovered within six months under mechanical treatment, also that 86 per cent recovered completely within the same time under operative treatment. Walker states that operation should always be practiced when a greater separation than an inch and a half is present, and when mechanical measures have failed.

**Suture of the Olecranon Process.**—The olecranon process is sutured for non-union after fracture and for recent fracture. Under strict asepsis expose the seat of fracture through a median longitudinal incision; uncover the fractured surfaces by removing intervening tissue or blood clots; begin at corresponding points of sound bone about a quarter of an inch from the border of either fragment and drill a small hole obliquely through the fractured surface; pass through the openings fine silver wire, silk, or kangaroo tendon, and firmly appose the fragments; close the wound, apply the dressings and immobilize the joint with the arm completely extended (Fig. 1531). The passage of kangaroo tendon or silk through the tendon of the triceps near to its point of insertion, and a hole made transversely through the ulna just below the fracture, is an admirable method of suture. In either instance the torn borders of the fibrous extension overlying the olecranon should be sutured together with catgut (Fig. 1532). In case the tendon is ruptured it is repaired in the same manner as is the tendon of the quadriceps extensor muscle.

*The Remarks.*—Suture of recent fracture of the olecranon is rarely advisable except when the separation is so great as to render doubtful the serviceability of the limb. In cases of crippling from non-union, the method

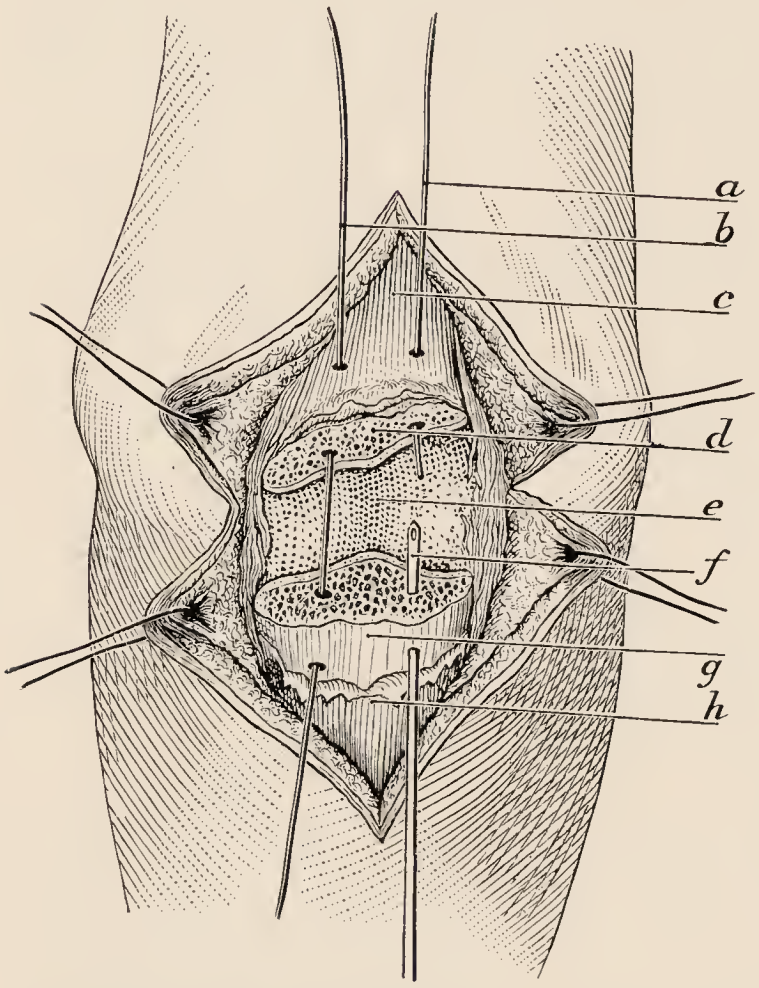



FIG. 1531.—The operation of suture of olecranon process. *a*, *b*. Wire sutures. *c*. Tendon of triceps muscle. *d*. Broken surface of upper fragment of olecranon. *e*. Trochlear surface of humerus. *f*. Bone drill. *g*. Lower portion of olecranon process. *h*. Periosteum.

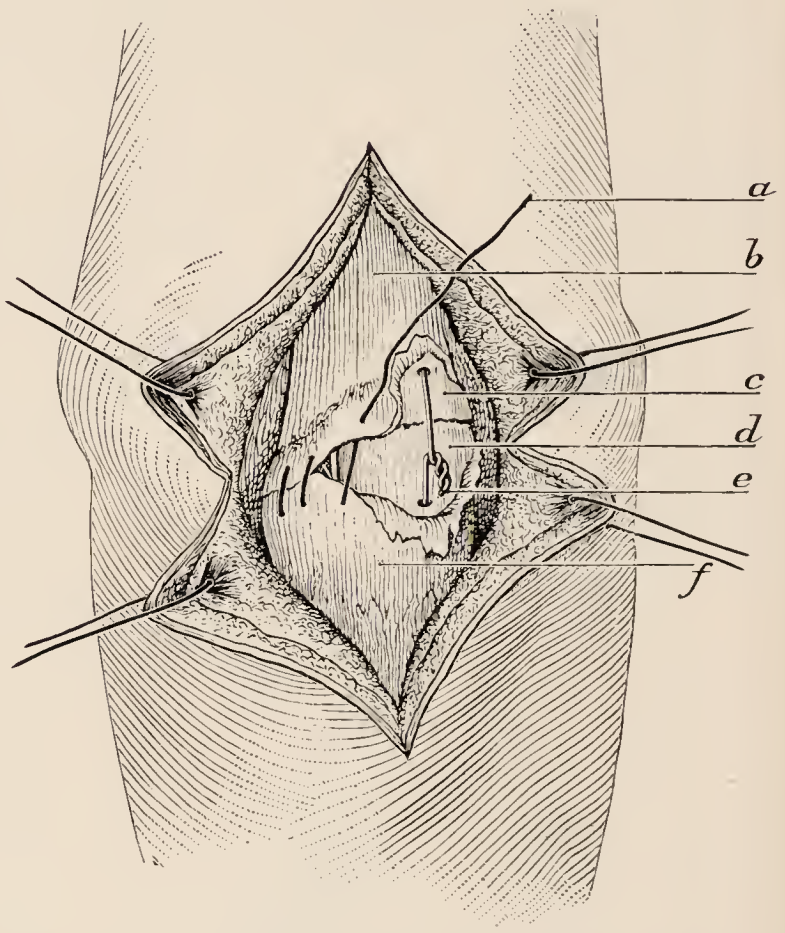



FIG. 1532.—The operation of suture of olecranon. *a*. Continuous suture uniting torn periosteum. *b*. Tendon of triceps. *c*. Upper fragment of olecranon. *d*. Lower portion of olecranon. *e*. Wire suture in place, ends twisted and turned down. *f*. Periosteum.

finds its greatest use. Passive motion should be commenced early and employed with caution. The suture should not be passed in contact with the articular surface.

**The Union of Fractured Long Bones.**—The fractured ends of a long bone sometimes persistently override each other in spite of the efforts to reduce and retain them in place, causing serious deformity, protracted and incomplete recovery, and perhaps exposing to injury important contiguous struc-

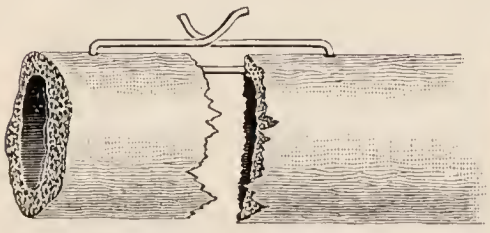


FIG. 1533.—Suture of transverse fracture with one suture. Another may be introduced at opposite side.

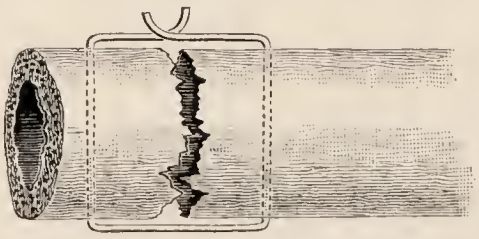


FIG. 1534. — Suture of transverse fracture with a single suture.

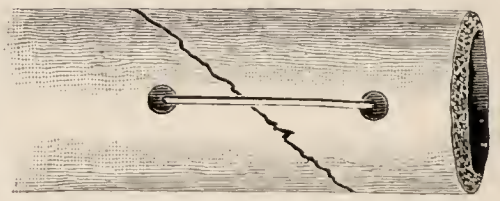


FIG. 1535.—Suture of oblique fracture with single suture. An insecure method.

tures. Both simple and compound fractures are often liable to these objections. It is proper, however, to state that attempts at relief by the following methods of treatment are now less frequently practiced than formerly, and

that their utilization is not wise unless prompted by considerations of more than usual interest to the welfare of the patient. *Three methods of uniting* the fragments are employed: 1, by suture; 2, by ligature; 3, by pegging.

*In suture of bone*, either silver or platinum wire or heavy silk may be employed.

*In transverse fracture*, perforate the bone perpendicularly to the surface and employ either two sutures, one at either side (Fig. 1533), or a single suture passing transversely through both fragments (Fig. 1534).

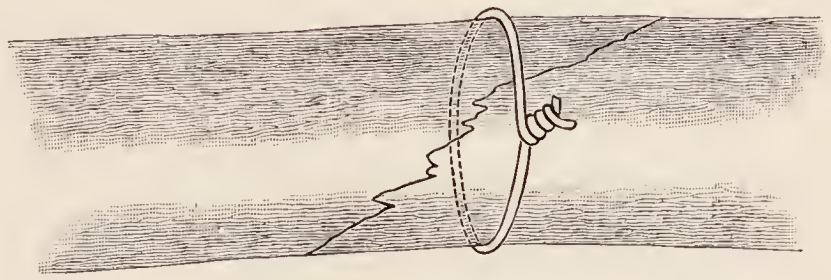


Fig. 1536.—Ligature of oblique fracture by peripheral method. Not the most secure.

*In oblique fracture*, drill the fragments so that the suture will be at right angles to the line of fracture, otherwise the movement is not controlled (Fig. 1535). The ends of the wire suture are twisted, the excess cut off, and the remainder hammered against the bone.

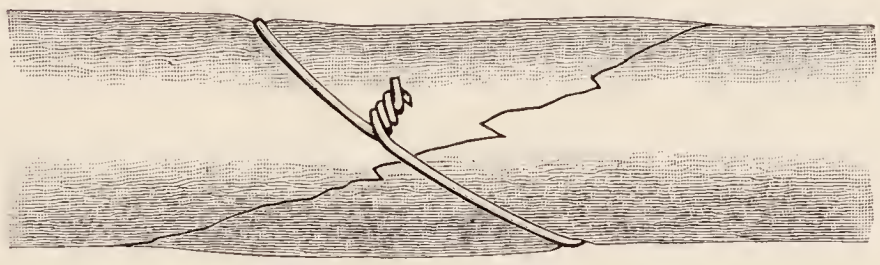


Fig. 1537.—Oblique ligature of oblique fracture, peripheral method. The most secure.

*Ligature of bone* is employed in cases of exceedingly oblique and comminuted fractures. In this method simple peripheral ligature and ligature combined with suture are employed.

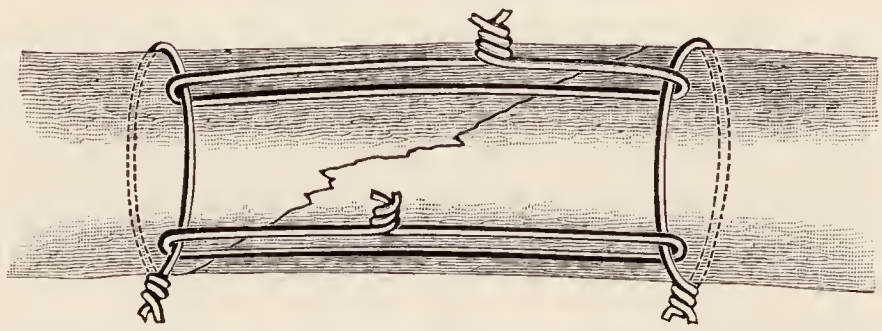


Fig. 1538.—Double circular ligature of oblique fracture, with two longitudinal loops. Ligatures should surround seat of fracture.

The former procedure, while not the most secure, is often serviceable. The ligature can be carried around the bone at the point of the greatest tendency to separation, either at right angles with the long axis of the bone (Fig. 1536) or with the direction of the fracture (Fig. 1537). In either instance the bone should be notched at the seat of application, to hold the ligature firmly in place, and supplementary suture may be made when needed. Two circular ligatures passed around the seat of fracture and united together with two longitudinal loops may be employed (Fig. 1538).

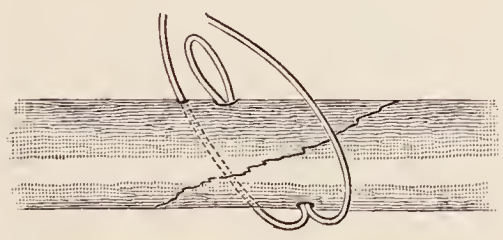


Fig. 1539.—Combined ligature and suture of oblique fracture.

Combined ligature and suture (Fig. 1539) is performed by drilling perpendicularly to the line of the fracture, through which opening a loop of wire is passed. The threads are crossed within the bone, then caused to encircle the bone snugly one at either side, and the protruding ends are passed through the loop and fastened. An accessory ligature may be employed if the fracture be very oblique.

*The frame ligature* provides the greatest degree of immobility. Drill two holes through the extremities at a right angle to the long axis of the bone (Fig. 1540), and pass the ends of a looped wire through them; draw the loop over the ends at the opposite side of the bone (Fig. 1541); draw the ends tight, carry them around the shaft of the bone to the openings, pass them beneath the respective wires, bring them together, and twist firmly in place (Fig. 1542).

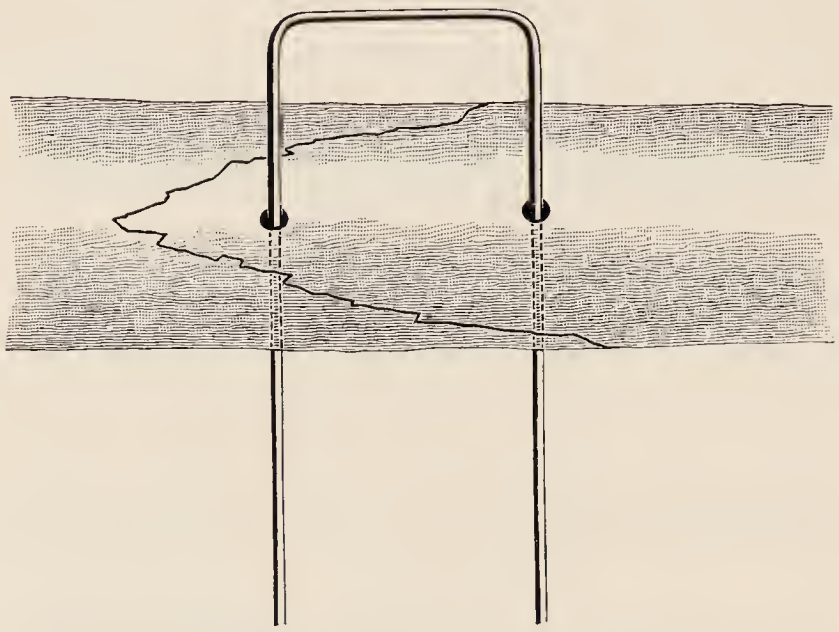


Fig. 1540.—Frame ligature of oblique fracture, first step.

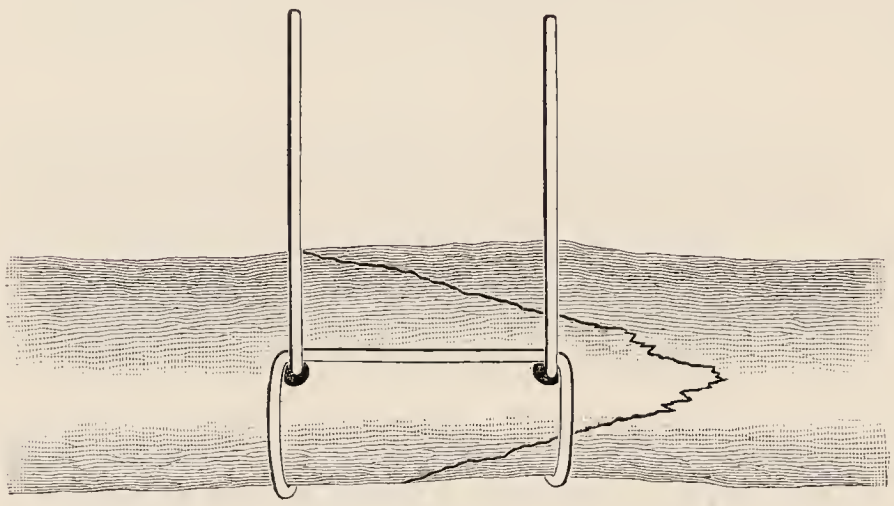


Fig. 1541.—Frame ligature of oblique fracture, second step.

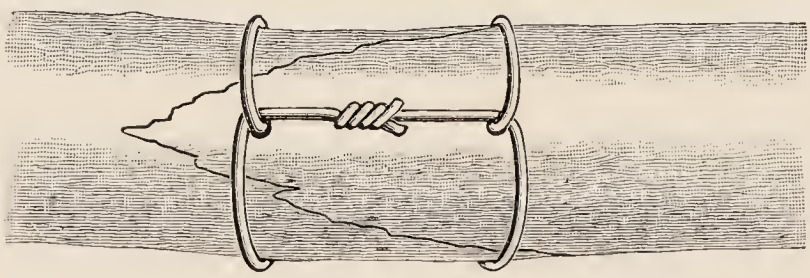


Fig. 1542.—Frame ligature of oblique fracture, operation completed.

*The pegging of fractures* by *peripheral* and *intramedullary* introduction of pegs of ivory or of decalcified and of fresh bone is not infrequently practiced. In oblique (Fig. 1543) and multiple (Fig. 1544) fractures, union by drilling and pegging together of the fragments is often a commendable procedure, better, in fact, than wiring.

*Intramedullary* pegging is practiced in the continuity of long bones (Fig. 1545) as follows: Make the site of the fracture gape by lateral flexion; drive the peg into the lower fragment with light strokes as far as suitable; grasp the lower fragment, bend it strongly laterally and downward until the free extremity of the peg can be introduced into the medullary cavity of the upper fragment, when the two are driven together. The periosteum is then sutured in place (Fig. 1546), the limb dressed aseptically and fixed by a plaster-of-Paris dressing.

In instances of loss of bone structure in which the periosteum corresponding to the intermediary space is intact, a peg may be introduced into the respective medullary openings of the upper and lower fragments, thus retaining them in their proper relation. The periosteum is then sewed around the peg and the limb dressed as before (Fig. 1547). In the young successful outcomes from this plan of practice are reported.

*The Remarks.*—Strict asepsis must be practiced and immobility secured if successful results are expected. Fragments of bone not properly vitalized,

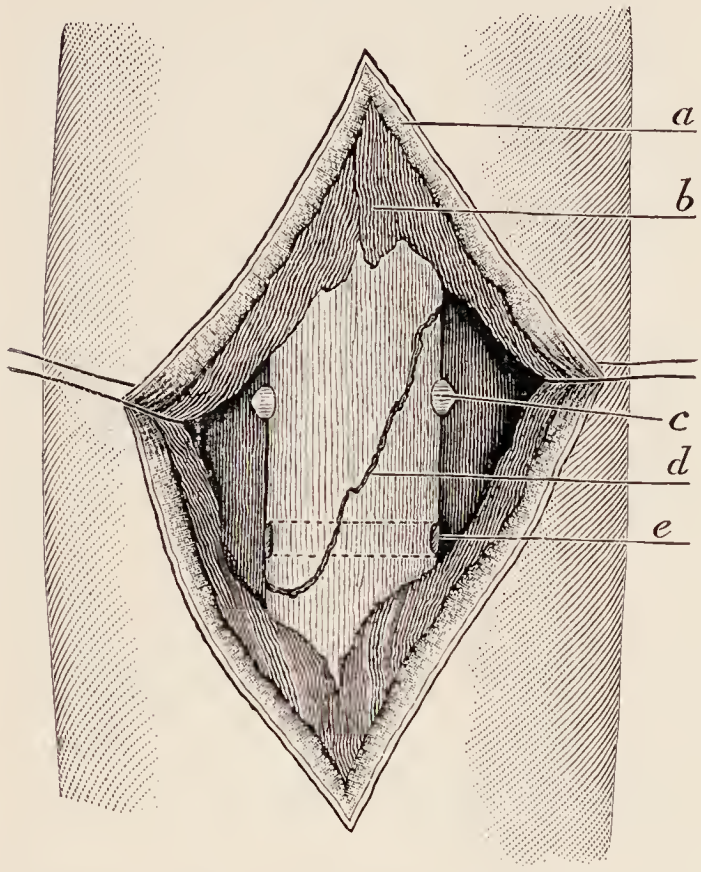



FIG. 1543.—Pegging single oblique fracture, peripheral method. *a*, *b*. Soft parts. *c*. Pegs. *d*. Line of fracture.

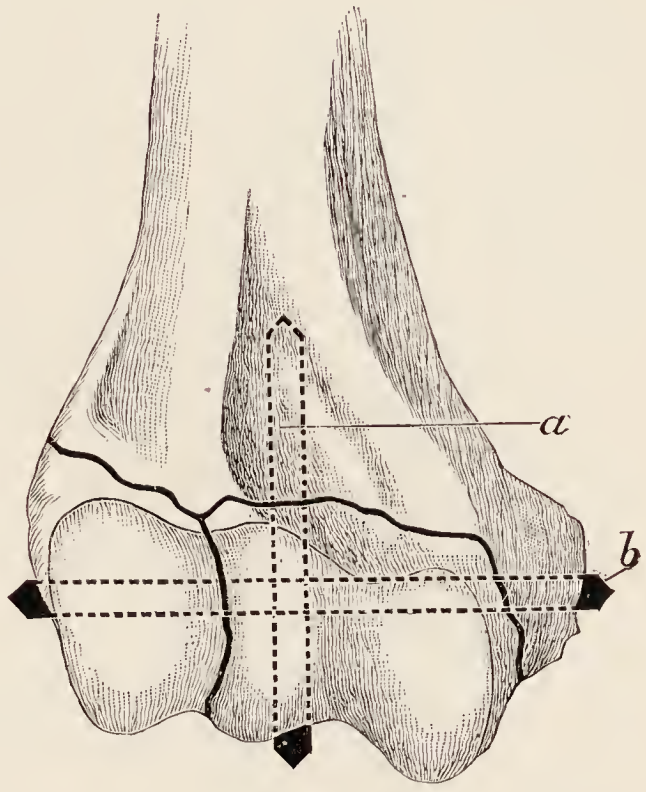



FIG. 1544.—Pegging multiple fracture, peripheral method. *a*, *b*. Vertical and transverse pegs.

because of crushing or of loss of periosteum, offer but little chance of proper repair. The form of suture or ligature should be employed that best meets the indication without causing undue disturbance of the soft parts and the fragments during its application. Pegging of long

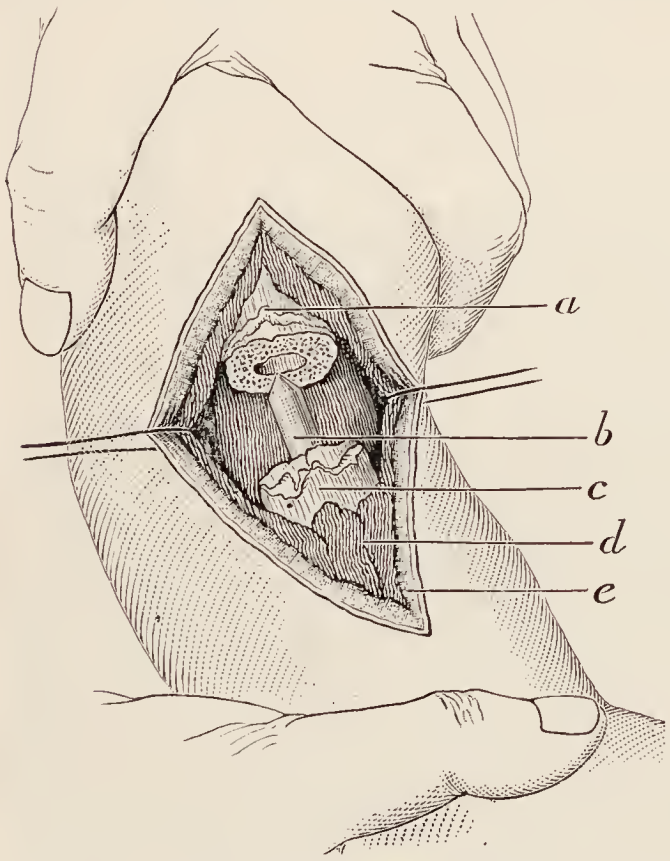



FIG. 1545.—Pegging fracture of long bone, intramedullary method. *a*. Periosteum of upper fragment. *b*. Pin with one end introduced. *c*. Periosteum of lower fragment. *d*, *e*. Soft parts.

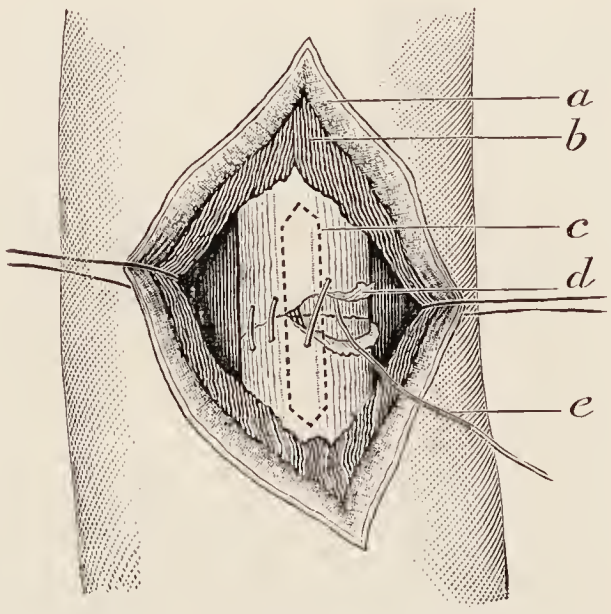



FIG. 1546.—Closing periosteum over pegged fracture of long bone by intramedullary method. *a*, *b*. Soft parts. *c*. Outline of pin. *d*, *e*. Sewing of borders of periosteum.

bones by the peripheral plan usually is better than union by suture or ligature. Ivory pegs are the easiest of introduction and of application. Decal-

cified bone is soft and suited only for certain cases. Fresh bone is excellent, but difficult to prepare. The pegs should snugly fit the openings, and be cut off so as to be readily covered with the periosteum. Medullary pegs should fit closely, and be introduced far enough to obviate lateral deviation—an inch to an inch and a half will suffice. However, the upper end of the peg can not be caused to penetrate the corresponding fragment as far as the lower.

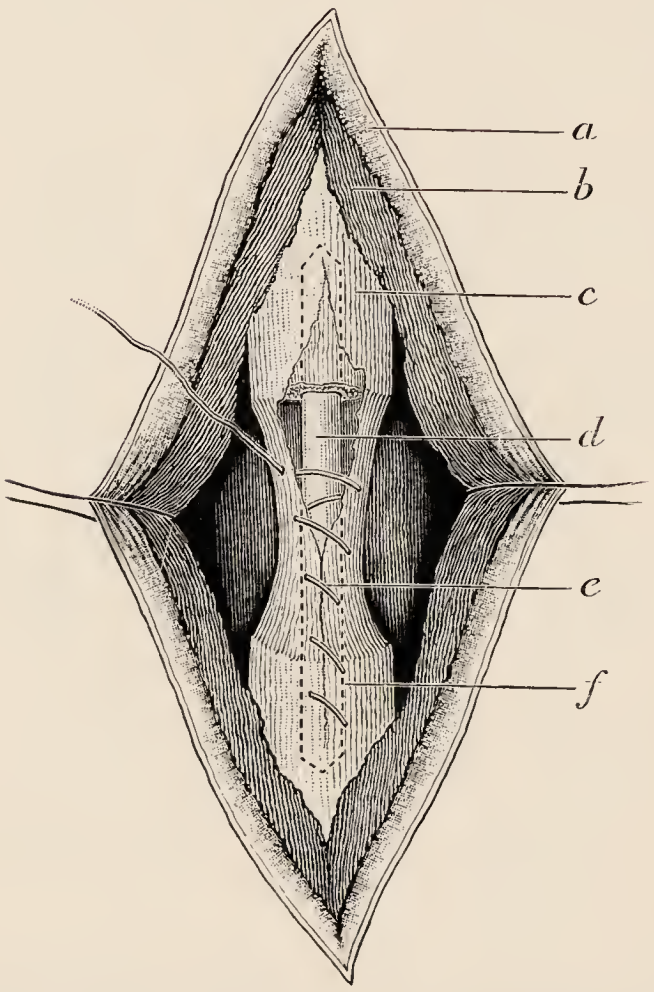



Fig. 1547.—Intramedullary pegging of fracture of long bone, with loss of substance, periosteum being sewed around peg. *a*, *b*. Soft parts. *c*. Periosteum. *d*. Peg. *e*. Periosteum sewed over peg. *f*. Outline of peg.

*Parkhill* has secured commendable results from fixation of the fragments by a special apparatus devised by himself. The ends of the fragments are suitably adjusted by means of resection, the use of the rongeur and Volkmann's spoon. "Each fragment is drilled transversely to the longitudinal axis of the bone in two places. A small steel pin is thrust into the first hole while the second is being drilled, in order that they may be made parallel. The distance that these pins should be from each other and from the ends of the bones, should be determined by the bone under operation and by the size of the clamp to be used. The screws are introduced into these holes by means of a clock key, and the wings are adjusted. While the bones are held in accurate apposition, the halves of the instrument are clamped together" (Fig. 1548). The soft parts are then accurately adjusted around the screws (Fig. 1549), and the dressing is applied, leaving the clamp outside. The apparatus is removed in from four to six weeks, depending on the size of

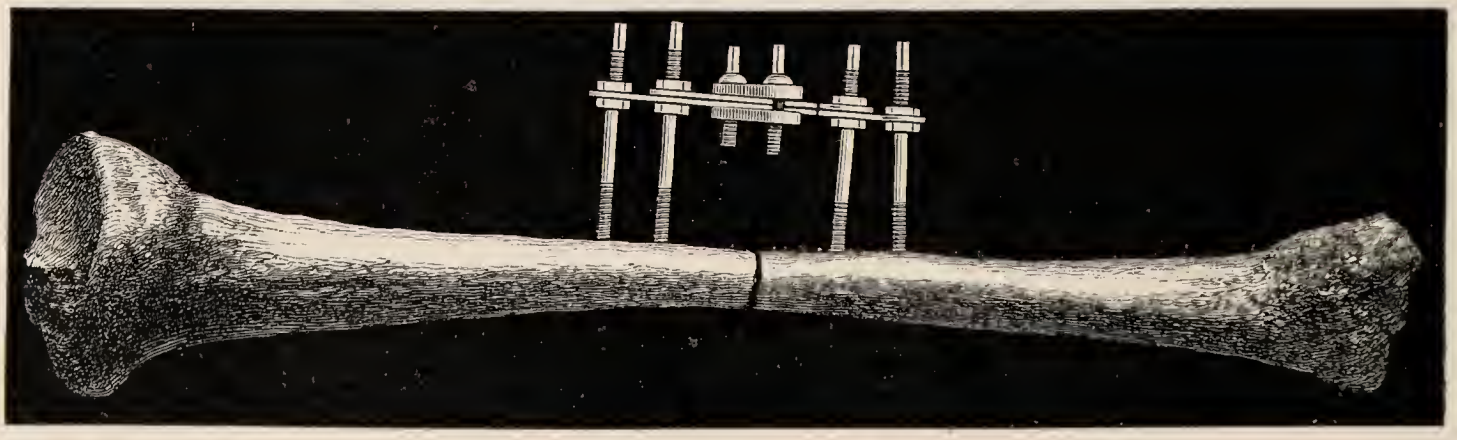


Fig. 1548.—Fixation of fragments in fracture of long bone, Parkhill's method.

the bone. The writer having had no experience in the use of this appliance, leaves its employment to the judgment of the profession. Parkhill's experience justifies a belief in its utility in suitable cases.

**Nailing the Head of the Femur.**—There are two conditions for the relief of which this procedure has been employed: first, for recent fractures, when

some coexisting condition, such as the age of the patient or the existence of some deformity, renders it inexpedient to subject the sufferer to prolonged mechanical treatment with the attendant risks of non-union and exhaustion; and, second, in cases of ununited fracture of the neck of the femur. Treatment by Buck's extension, until so far as possible the normal length is restored, should precede all operative attempts.

The operative treatment in these cases was first suggested by Langenbeck, and successfully carried out by Koenig.

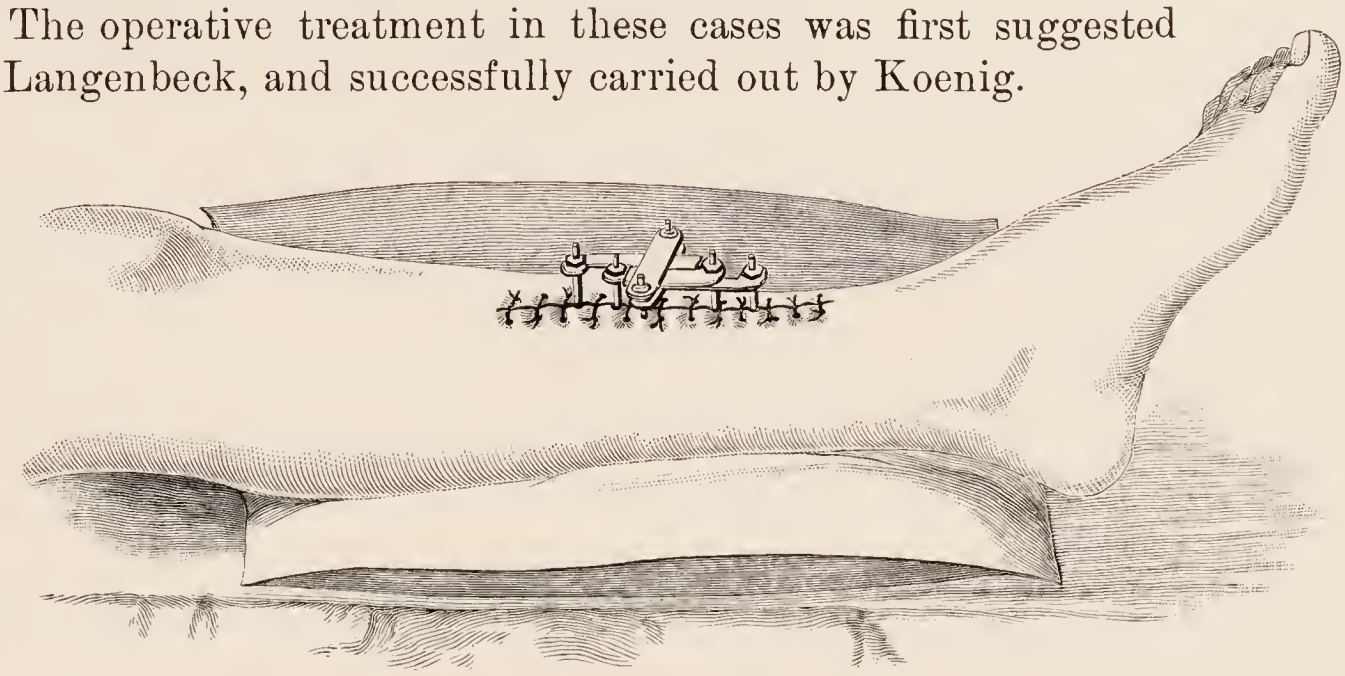


Fig. 1549.—Fixation of fragments in fracture of long bone, Parkhill's method. Soft parts adjusted.

*Koenig* operated in a case of recent fracture, making a small incision over the outer side of the trochanter major, drilled a hole through it with a metal drill in the direction of the head of the bone, applied extension to the limb to the extent necessary to overcome the deformity, and then drove a long steel nail through the canal in the trochanter into the head of the bone and left it there. The limb was then immobilized and extended for six

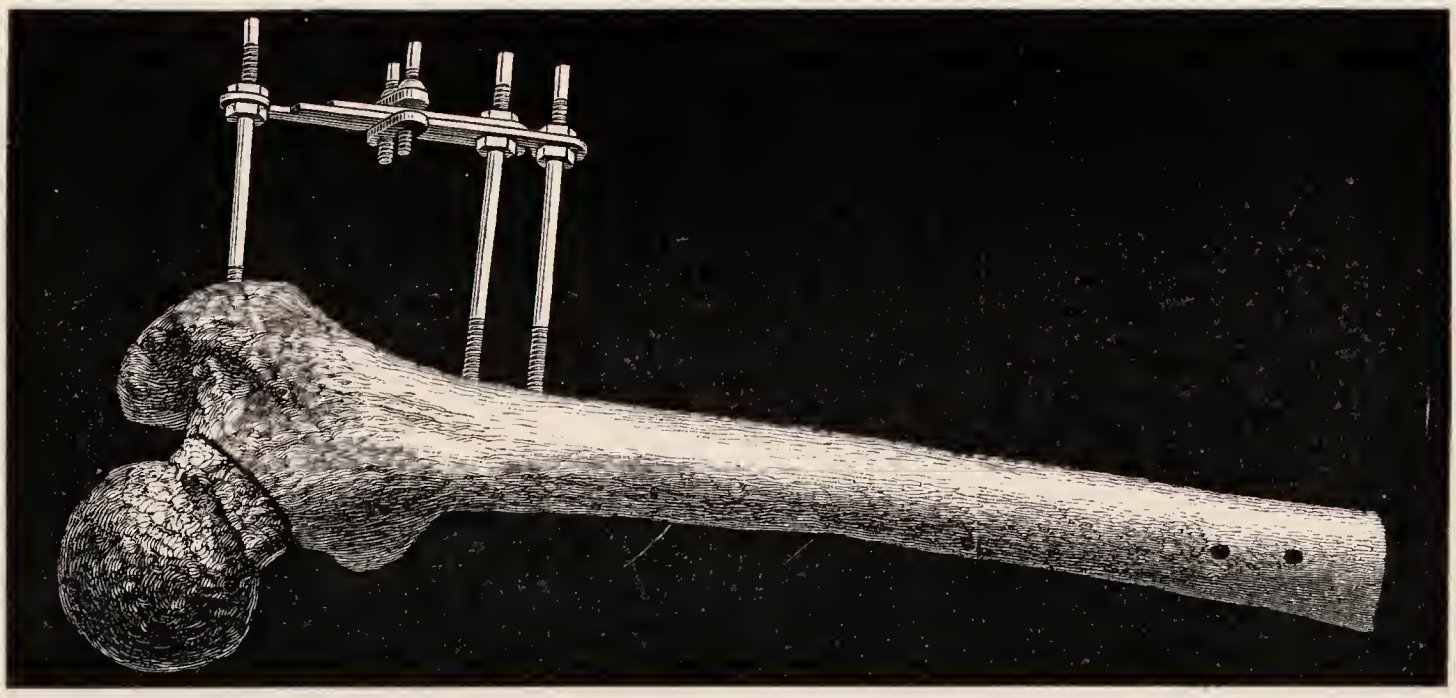


Fig. 1550.—Fixation of fragments in fracture of neck of femur, Parkhill's method.

weeks. There is no record of the ultimate shortening, but good union and free motion of the joint were obtained.

*Cheyne*, in a case of recent fracture, exposed the fragments through a longitudinal incision made over the anterior aspect of the joint, exposed the

fracture, made extension and internal rotation on the limb, and with the fingers in the wound manipulated the fragments into place; then a small longitudinal incision was made over the outer side of the trochanter major, and two canals drilled through the fragments at a distance of half an inch apart. Ivory pegs were then driven through the holes made by the drill, and the limb immobilized. Good union and motion were obtained, but there is no record of measurements of the limb.

In operating upon cases of ununited fracture the refreshing of the ends of the fragments is a necessary step in the technique.

*Meyer*, in a case of ununited fracture with three inches shortening, made the Langenbeck incision for excision of the hip joint (Fig. 393), exposed the seat of fracture, scraped the ends of the fragments until they bled, reduced the deformity by extension of the limb, and fastened them together by driving two nails through the trochanter major. A useful joint was obtained, with an inch and a half shortening of the limb. *Parkhill* commends this method for fracture of the neck of the femur (Fig. 1550).

*Gillette* reports three cases of ununited fracture of the neck of the femur operated upon of the following manner:

A horseshoe incision with its convexity downward was made, beginning an inch below and an inch posterior to the anterior superior spine of the ilium, carrying it down two inches below the trochanter major and bringing it up the buttocks to about the center of the gluteus maximus muscle. The skin and the two layers of fascia were dissected up *en masse*. A chain saw was then passed between the posterior border of the tensor vaginæ femoris and the gluteus medius, hugging the neck of the femur and the base of the trochanter major; it was brought out between the posterior surface of the gluteus medius and the anterior surface of the gluteus maximus; the trochanter major and its muscular attachments were sawed off, turned back, thus exposing the capsule of the joint. Then, by making a longitudinal incision into the capsule the fracture could be easily seen. The surfaces of the fractured ends were denuded and a bone peg driven through the neck of the femur, thus holding the fractured ends together. The capsule was stitched with catgut, the trochanter major restored and nailed in place with a small bone peg, the skin closed, and the limb immobilized.

There was union and good motion obtained in all the cases, with shortening of from an inch to an inch and a half.

*Curtis*, in a case of ununited fracture of the neck of the femur of three months' standing, exposed the fracture through an anterior incision, passed a drill into the callus and between the fragments to cause irritation, applied extension to the limb and reduced the deformity, after which a drill was passed through the trochanter major from the outer side, transfixing the fragments; the handle of the drill was then removed and the drill itself left *in situ*. The anterior wound was closed and the limb immobilized. The extension was maintained for six weeks, at the end of which time the drill could be easily removed. Good union and a useful limb were obtained with three quarters of an inch shortening.

There is yet a reasonable doubt regarding the advisability of this operation except in special cases. The difficulty of securing and maintaining proper adjustment of the fragments because of the lack of command of the inner portion, its porous character and low vitality, present obstacles to success that can not be gainsaid. The degree of shortening that follows the successful results suggests an initial failure of reduction of the deformity or the maintenance in proper place, and bespeaks in any event a considerable amount of absorption at the seat of the fracture. A more extended experience is needed and a careful comparison of the favorable results by different methods of treatment is required before a final judgment can be recorded.

**Movable Bodies in Joints.**—Movable bodies in joints, joint derangement, defective semilunar cartilages, and synovial folds are conditions quite often confused with each other, and, in fact, are seldom positively distinguishable without a physical demonstration. If a movable body appear beneath the surface, the patient should remain as quiet as possible pending the arrival of the surgeon, who should then transfix it at once with a sharp needle, if feasible, to prevent its escape into the recesses of the joint while preparation is being made for its removal. Strict asepsis should be enjoined in every respect. Either an oval incision, including the site of the movable body, or one made directly upon it, may be employed. The tissues are divided carefully down upon the object, and it is then removed if disconnected, and clipped off with scissors if connected, as it sometimes is, to the semilunar cartilage or synovial fold. The synovial incision is carefully and independently closed with a continuous suture of fine chromicized catgut. The incision in the fibrous capsule should be treated in a similar manner. The remaining portion of the wound is closed with interrupted silkworm-gut sutures. If it should appear that the trouble is dependent on derangement of a semilunar cartilage, and the obstinacy of the affliction forbids the expectation of other than operative relief, a transverse or a broad-based oval incision with the base upward should be made over the seat of the cartilage in question. The joint is carefully opened, the cartilage exposed to view, and its movements carefully noted as the leg is flexed and extended. If it be too freely movable because of a stretched or ruptured coronary ligament, thereby permitting it to be caught between the advancing articular surfaces, the ligament should be shortened and sewed with chromicized catgut to the periosteum at the border of the tibia. If the ligament has been torn away from its fastening to the tibia, it should be restored in place and fastened the same as before, by sewing. If it be roughened or deformed so as not to operate without a hitch, its movements should be restricted as much as possible by sewing in the manner already stated. If it be doubled upon itself, or so much deformed as to unfit it for use, it should be removed at once.

*The Precautions.*—Strict asepsis should be applied throughout the operation. Antiseptic solutions ought not to be permitted in contact with the exposed surfaces, especially those of the joint cavity itself. The exploration of the joint cavity through a free incision for the purposes of diagnosis

and possible removal of the offending cause should not be attempted unless it shall appear that the burden of the infliction and of its consequent effects on the joint are of equal significance to those arising from explorative practice.

*The Remarks.*—The cartilages are normally movable because of the need of their action to facilitate the functions of the joint. The diagonal division into two parts of a too freely movable cartilage, and the stitching of each independently to the periosteum at the border of the tibia, is commended by some operators. The divided borders of the respective tissues of the wound are united the same as in the preceding instance. Drainage need not be made unless faulty technique is suspected. Operative practice is not advised until after other and simpler means of relief have failed, except when a movable body presents itself beneath the surface, and then, should it escape into the joint, it is better to await a reappearance than to open the joint and seek for it at once. Transverse incisions weaken the joint more than the vertical.

*The Results.*—The following statistics will emphasize the outcome of operative practice more pointedly than words alone can do. Also the comparative importance of aseptic measures and perfected technique are strikingly shown:

| | Number of cases. | Cured per cent. | Failures per cent. | Mortality per cent. |
|---|---|---|---|---|
| Beamdorf | 216 | 66.2 | 18.99 | 14.81 |
| Lorry (1860) | 167 | 68.86 | 19.76 | 11.38 |
| Browne (1884) | 88 | 82.95 | 5.68 | 12.36 |
| Tuttle | 107 | 97.19 | 2.81 | ..... |

**The Frontal Sinus.**—It is sometimes necessary to open the frontal sinus to liberate inflammatory products and remove foreign bodies, etc.

*The Anatomical Points.*—The frontal sinuses are spaces developed at either side by separation of the tables of the skull at that situation. The development begins at about two years of age and continues usually during life, so that the sinuses are therefore largest in old age. They vary in capacity, sometimes being an inch in depth, and may extend halfway up the forehead. They are commonly separated in the median line from each other by a bony septum, are lined with mucous membrane, and communicate freely with the nasal cavity through the infundibulum.

*The Operation of Opening a Frontal Sinus.*—Shave and cleanse the supraorbital area thoroughly, administer an anæsthetic, and place the patient on the back with the shoulders raised and the head extended; make an incision from the center of the supraorbital ridge inward along the upper border of the eyebrow to the median line above the root of the nose; raise and push aside the periosteum, and with a chisel or mallet make a small opening through the anterior wall of the cavity (Fig. 267); cleanse the sinus thoroughly and remove the diseased products. The wound of the soft parts should be closed at once, except at the inner angle, which is left open for drainage purposes. If the infundibulum be patent the external wound may

be entirely closed at once. It is better, however, to introduce a strand or two of silkworm gut through the canal into the nasal cavity, leaving the upper ends exposed at the angle of the wound for two or three days before removal, than to rely at once on the uncertainties of the maintenance of drainage along narrow channels lined with mucous membrane with fickle characteristics. When extensive disease is present requiring much time for cure, it is wise to drain through into the nose or pharynx with a tube of considerable size (Fig. 1551).



Fig. 1551.—Draining frontal sinus into pharynx.

*The Comments.*—All that is practicable should be done to prevent scarring and infiltration of the loose tissues about the orbit. The eyes should be carefully protected from the discharges and from the antiseptic fluids employed in the treatment. The infundibulum runs downward and backward for a short distance, then turns sharply forward and downward, and enters the nasal cavity—facts that should be remembered in probing the canal.

**The Maxillary Sinus.**—The maxillary sinus or the antrum of Highmore is of great importance in connection with facial disfigurement and functional impediment, due to encroachment on the orbital and nasal fossæ of the morbid products arising from disease of the antrum.

*The Anatomical Points.*—The antrum of the adult is a triangular-shaped cavity of considerable size, bounded above by the orbital floor, below by the alveolar process, within by the wall of the nasal fossa, and without by the malar process of the maxilla. It is lined with mucous membrane and communicates with the middle meatus of the nasal fossa by a small opening. The relation of the floor of the antrum to the roots of the teeth varies widely; it may extend so as to correspond to the roots of nearly all the teeth of the true maxilla, or may be so contracted as to bear a definite relation with only one or two of the posterior molars. Occasionally the roots of one or more of the posterior molar teeth project into the floor of the antrum, incased, however, normally by a thin plate of bone covered with mucous membrane.

*The Operation of Opening the Maxillary Sinus.*—The antrum is opened through the socket of a molar tooth, or through the facial surface of the maxilla, at a point corresponding to the root of the second or third molar tooth. In the former instance the second or third molar tooth is extracted and the socket is perforated above by means of a bone drill carried carefully upward through the floor of the cavity. If the tooth in question be diseased, the removal only may suffice to secure an opening. In either instance the opening should be enlarged sufficiently by the introduction of a larger drill

to permit of a free discharge and cleansing of the cavity. When the available teeth of the afflicted side have been long removed and atrophy of their former sites has taken place, the opening is then made at a point on the anterior surface of the bone corresponding to the former location of the second or third molar tooth. The cheek is drawn aside and the lip turned upward, followed by an incision of the mucous membrane and periosteum over the selected site. The soft parts are drawn aside, the bone exposed and perforated in an upward direction by means of a small trephine, or a large trocar, or bone drill, or strong scissors.

*The Precautions.*—It is wise to first remove the diseased tooth that complicates the antrum involvement, as it only may be the exciting cause of the trouble. The perforating agent should be introduced with care and proper restraint, or it may perforate the floor of the orbit. A careful examination of the diseased products should be made at once, to determine the nature of the disease. If a scoop be used to remove the diseased tissue, care should be taken not to needlessly expose healthy bone, as necrosis will quite surely follow the exposure. Careful cleansing and complete control of the entrance of food through the opening should be maintained, for obvious reasons.

*The Comments.*—Whether or not a sound tooth should be sacrificed to afford a point of entrance, or an opening of the facial surface be made at once, is a matter of some dispute. In our opinion the former plan will give greater satisfaction in the majority of instances, because the opening is likely to exist for a long time, and often is permanent. In the latter class of cases much better control can be had of the exit and entrance of matters than when the opening is at the facial surface.

*The After-treatment.*—Thorough cleanliness should be maintained by frequent cleansing of the cavity through the opening until the disease is cured. For this purpose the aperture should not be allowed to close until final relief is secured, when, if closure will follow without discomfort, it may be encouraged. A tube with an adjustable plug may be worn in either case, but one connected with an appliance fitted to the gap left in the biting line from the removal of the tooth is less annoying and better controlled than one inserted in an opening at the anterior surface. A competent mechanical dentist can do much to increase the comfort and efficiency attending the employment of continuous drainage.

**Operations on the Cervical Sympathetic Nerve.**—*Jonnesco* describes three degrees of operative practice on the nerve that can be employed for relief from disorders related to the sympathetic nerve influence:

1. Simple incision; 2, partial resection; 3, total resection.

Other surgeons preceded Jonnesco in the practice of partial resection, limited, for example, to the superior cervical ganglion of both sides (Alexander), the middle ganglion of the left side (Bojdanick). Jonnesco was first to excise the entire sympathetic in the neck.

*The Operation.*—With the shoulders and head raised, and the head turned to the opposite side and exposed to a good light, make an incision from the posterior border of the mastoid process downward, along the posterior margin of the sterno-cleido-mastoid to a point a little below the clavicle; expose

and divide the external jugular vein between two ligatures; isolate the posterior border of the sterno-mastoid and split it in the continuity of the structure near to the margin; separate the deeper tissues along the line of incision, carefully avoiding injury to the associated vascular and nervous structures; draw apart the borders of the wound and seek for the nerve near the middle of the wound as it lies in its established relations with the sheath of the carotid, the longus colli, and scalenus anticus muscles (Fig. 1552); expose and follow upward the trunk of the nerve to the superior

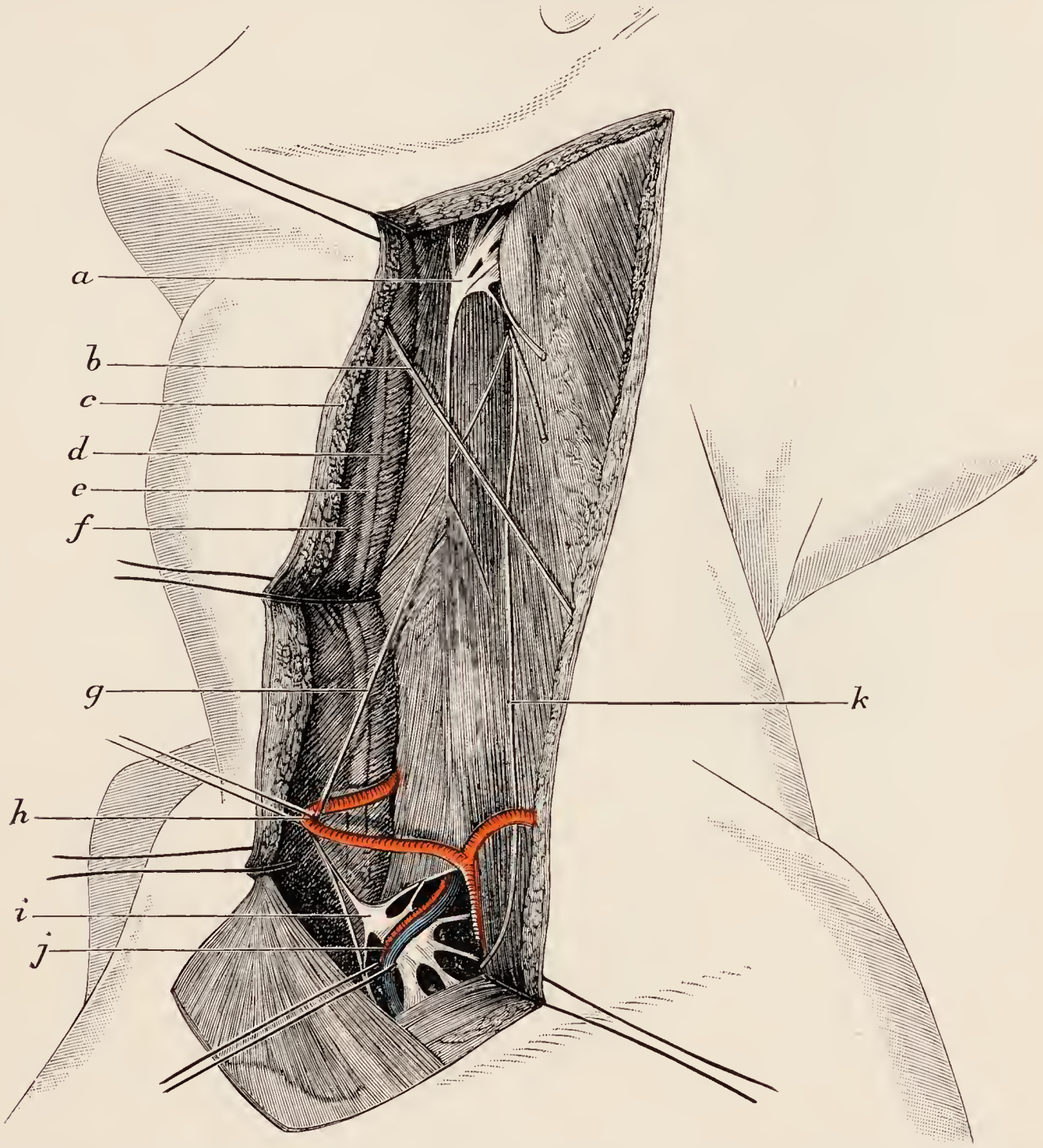



FIG. 1552.—The cervical sympathetic nerve and ganglia. *a*. Superior cervical ganglion. *b*. Branch of cervical plexus. *c*. Sterno-mastoid muscle. *d*. Common carotid artery in sheath. *e*. Pneumogastric nerve in sheath. *f*. Internal jugular vein in sheath. *g*. Branch of sympathetic. *h*. Inferior thyroid artery. *i*. Inferior cervical ganglion. *j*. Vertebral artery and vein. *k*. Phrenic nerve.

ganglion (*a*); isolate the ganglion, divide its communicating filaments and those of the exposed trunk of the nerve, and remove the ganglion and the trunk; seize with forceps the distal end of the lower part of the trunk and put it upon the stretch; separate downward carefully the trunk from the contiguous tissues to the inferior thyroid artery; dissociate cautiously the artery from the intimate intervals of nerves, in the midst of which may

be found and isolated the middle cervical ganglion (Fig. 1553); trace still further downward the main trunk deeply into the neck and seek for the inferior ganglion where it lies behind the clavicle, closely associated with the head and neck of the first rib and the pleura beneath (Fig. 1554); apply a retractor at either side of the wound so as to include externally the scalenus anticus muscle, thyroid, suprascapular, and vertebral arteries and veins; at the inner side the sterno-cleido-mastoid muscle and deep vessels; grasp with forceps and free the ganglion by blunt dissection from the vertebral vessels without and the costo-vertebral structures within; divide with small, blunt-pointed scissors the ramifications of the ganglion, cautiously shunning the important contiguous structures, and remove it along with the portion of trunk attached above; arrest hæmorrhage and unite the borders of the wound by deep and superficial sutures; dress the wound aseptically, confine the head and neck closely, and quiet the patient with an anodyne.

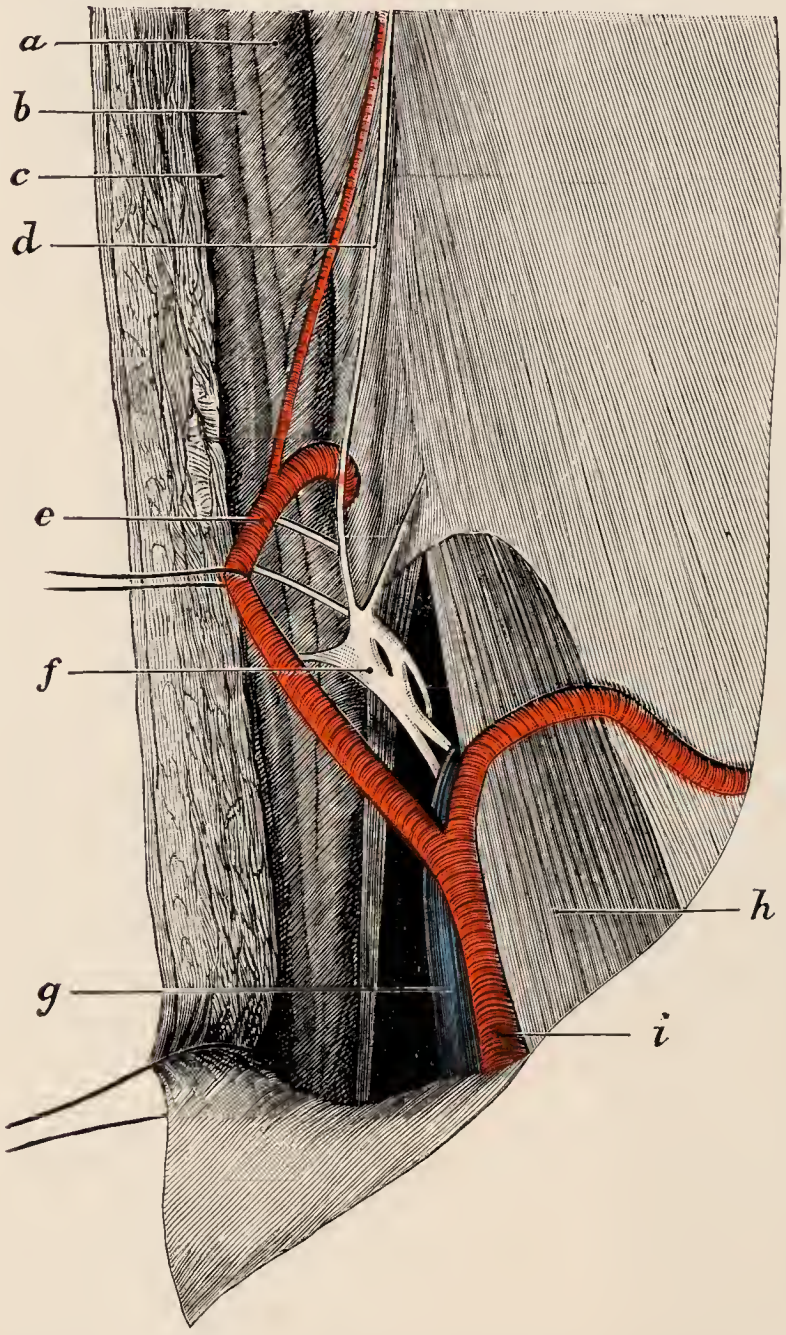



FIG. 1553.—The middle cervical ganglion of cervical sympathetic nerve. *a*. Common carotid artery in sheath. *b*. Pneumogastric nerve in sheath. *c*. Internal jugular vein in sheath. *d*. Sympathetic nerve. *e*. Inferior thyroid artery. *f*. Middle cervical ganglion. *g*. Vertebral vein. *h*. Scalenus anticus muscle. *i*. Thyroid axis.

*The Precautions.* — Thorough asepsis and a clear appreciation of the anatomy embraced in the procedure are essential requirements. Involvement of the pleura and important vessels and nerves is to be avoided. Be not too confident of a favorable therapeutic outcome.

*The Remarks.* — *Jonnesco* regards approach to the nerve by splitting the posterior border of the sterno-mastoid muscle as less troublesome than exposure of and passing under the border. The superior ganglion is the largest of the three, is located opposite the second and third cervical vertebræ, sometimes as low as the fourth or fifth. It lies behind the sheath of the carotid and upon the rectus capitus anticus major muscle. The middle ganglion is the smallest of the three and is sometimes wanting. It is located opposite the sixth cervical vertebræ, is closely associated with the inferior thyroid artery, hence denominated thyroid ganglion. The inferior cervical ganglion is situated between the base of the transverse process of the last cervical vertebra and the neck of the first rib at the inner aspect of

the superior intercostal artery. It is next in size to the superior ganglion. The inferior ganglion usually lies inside the vertebral artery and invests this vessel with its branches. Sometimes this ganglion is friable and removed piecemeal.

*The Results.—Jonnesco* reports the following outcome secured by himself and others in this operation :

1. *Simple incision* has been done by Jaboulay three times with good operative results, but the possibility of regeneration at the seat of division makes this method of practice untrustworthy.

2. *Partial Resection.*—All the nerves down to the thyroid artery and the superior ganglion have been removed 12 times by six different operators. In 14 cases 5 are reported cured, 2 relapsed, and 7 not definitely stated. Jonnesco reports 7 instances practiced *for glaucoma*, in all of which the operation was limited to the superior ganglion. Post-operative effects slight

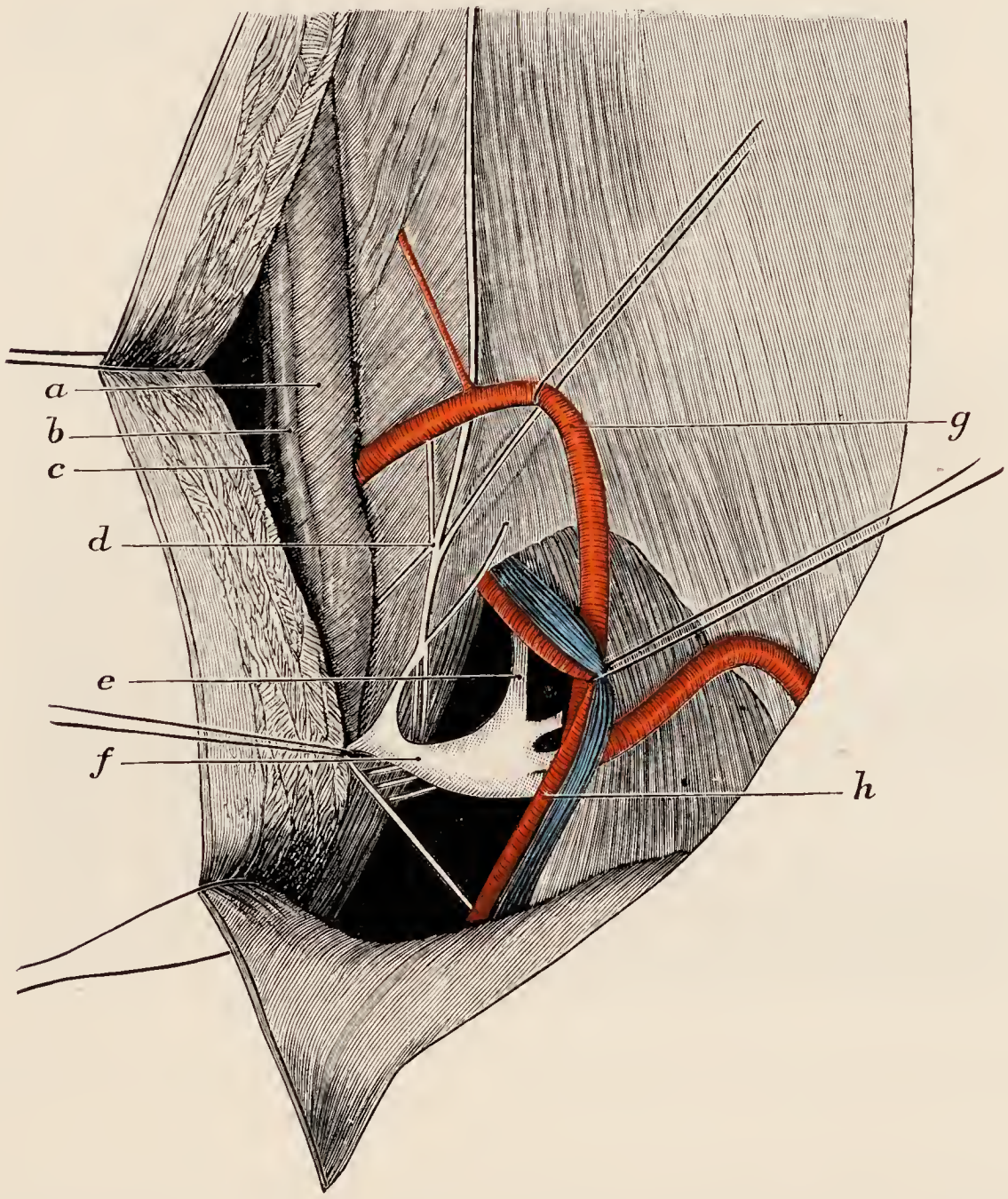



FIG. 1554.—The inferior cervical ganglion and the sympathetic nerve. *a.* Internal jugular vein in sheath. *b.* Pneumogastric nerve in sheath. *c.* Internal jugular vein in sheath. *d.* Middle cervical ganglion. *e.* Vertebral nerve. *f.* Inferior cervical ganglion. *h.* Vertebral artery and vein. *g.* Inferior thyroid artery.

and transitory. Immediate reduction of intraocular tension and progressive amelioration of vision followed. Jonnesco also reports 26 *epileptics* who

were subjected to the operation. In "some cases" the cure was maintained for a year, others were notably improved both as to frequency of fits and mental state. All were improved and no case was made worse.

*Rehn* reports 32 cases of Graves's disease treated by operation on the cervical sympathetic with 28.1 per cent cured, 50 per cent improved, 12.5 per cent not relieved, and 9.3 per cent died. He also shows that above twice as many cases follow thyroid extirpation as attend operation on the sympathetic with, however, a higher rate of mortality, viz., 13.6 per cent, and 9.3 per cent respectively.

**The removal of foreign bodies from the hand** and elsewhere about the human body through a longitudinal incision made directly down upon the supposed site, and by means of a >-shaped incision so placed that the apex of the > should conform with the point of entrance of the foreign body and the limbs to its direction in the tissues, and located so as to include in the triangular flap the object sought for, are methods of practice of good repute, long since established. The employment of these methods has, however, been followed by disappointed effort in the search and by severe after-effects. The advent of the X ray reduced the hitherto uncertain outcome of sightless operative effort to the basis of substantial scientific success in all instances. But a single instance is needed to illustrate the plan of action employed by the writer. In this particular instance long, tedious, and unsuc-



FIG. 1555.—Locating in right hand a foreign body by the X ray, palmar view. Scar indicated by longitudinally placed pin. Area divided into equal spaces by three transversely placed pins. Foreign body seen at ulnar side of longitudinal pin.

cessful search under general anæsthesia had failed to locate a fragment of broken needle. In this, as in other instances, a fine needle was carried superficially through the toughened cuticle in the long axis of the scar caused by the previous effort. This step caused no pain and the needle was held securely in place. Three additional needles were then passed through the cuticle at right angles to the preceding needle at definite equal distances from each other, thus dividing the corresponding area into four equal spaces.

An X-ray photograph was then made of the palmar and lateral aspects of the hand (Figs. 1555 and 1556), showing the depth in the tissues of the foreign body and its comparative relation to the topography outlined by the needles.



FIG. 1556.—Locating in right hand a foreign body with X ray, side view. Showing depth of foreign body and its relation to the pins on palmar surface.

The proper seat of incision for removal of the foreign body is thus made obvious, and one has but to adhere to the line of incision without deviation with an abiding faith in success.

*The Remarks.*—The extremity should be placed in a even manner on a horizontal surface when photographed. After the picture is taken the needles should be removed and their respective sites indicated on the surface for subsequent observation.

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